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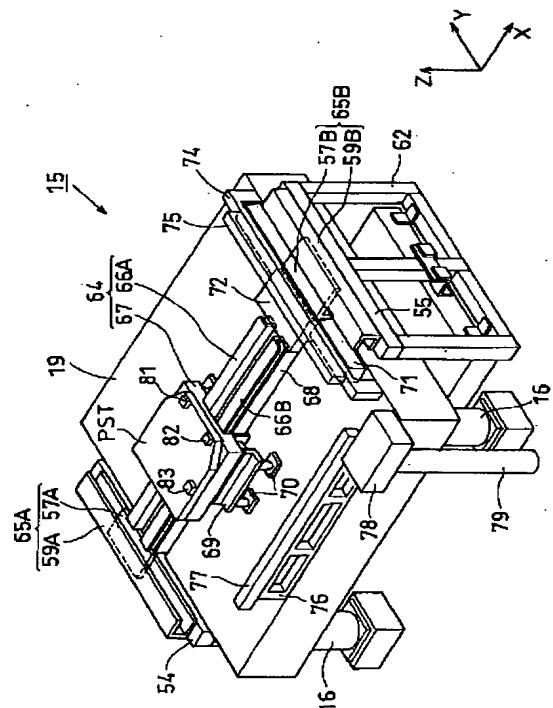
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(54) 【発明の名称】 ステージ装置及び露光装置

(57) 【要約】

【課題】 可動部重量を増加させることなく長いストロークを実現することができ、高い制御性能と高い位置決め精度が得られるステージ装置を提供する。

【解決手段】 長尺鏡75、77を可動しない部分に固定し、ステージ装置の可動部PSTの軽量化を実現するとともに、ステージを駆動する駆動部（アクチュエータ）とレーザ干渉計の読み取りの相対位置がステージ移動によって変わらない構成とする。ステージ位置制御のためのアクチュエータとステージ位置計測のためのレーザ干渉計読み取り位置とが、ステージの位置によらず常に一定となるため、制御コントローラ的设计が容易となる。



【特許請求の範囲】

【請求項1】 第1方向と第2方向とに移動可能な可動ステージと、ベース部材に設けられた長尺鏡に対する前記可動ステージの位置を検出する位置検出装置とを備えたステージ装置において、前記長尺鏡に対する前記可動ステージの位置を検出する検出光を前記可動ステージに設けられた光学装置を介して前記長尺鏡に送光する送光光学系と、前記可動ステージの前記第1方向の移動に応じて、前記送光光学系を前記第1方向に移動させる移動装置とを備えたことを特徴とするステージ装置。

【請求項2】 請求項1記載のステージ装置において、前記ベース部材は前記可動ステージを移動可能に支持していることを特徴とするステージ装置。

【請求項3】 請求項1又は2記載のステージ装置において、前記移動装置は前記可動ステージを前記第1方向に移動させることを特徴とするステージ装置。

【請求項4】 請求項1～3のいずれか1項記載のステージ装置において、前記可動ステージを前記第2方向に移動させるステージ移動装置を備えたことを特徴とするステージ装置。

【請求項5】 請求項4記載のステージ装置において、前記ステージ移動装置が前記可動ステージを移動させる移動軸と、前記可動ステージに設けられた前記光学装置と前記長尺鏡の間の光軸とはほぼ一致していることを特徴とするステージ装置。

【請求項6】 請求項1～5のいずれか1項記載のステージ装置において、前記位置検出装置は、前記ベース部材とは振動的に分離した振動分離部材に配置された検出器を備えていることを特徴とするステージ装置。

【請求項7】 マスクステージに保持されたマスクのパターンを基板ステージに保持された基板に露光する露光装置において、前記マスクステージと前記基板ステージとの少なくとも一方のステージとして、請求項1から6のいずれか1項記載のステージ装置を用いたことを特徴とする露光装置。

【請求項8】 請求項7記載の露光装置において、前記マスクのパターンを前記基板に投影する投影光学系を備えたことを特徴とする露光装置。

【請求項9】 請求項8記載の露光装置において、前記投影光学系と前記長尺鏡とは共通の部材により保持されていることを特徴とする露光装置。

【発明の詳細な説明】

【0001】

【発明の属する技術分野】本発明は、半導体デバイスや液晶表示パネルの製造工程で基板にパターンを露光する露光装置及びその露光装置に組み込まれるステージ装置

に関する。

【0002】

【従来の技術】図8は従来のステップ・アンド・スキャン方式の走査型露光装置の概略図、図9はその基板ステージ(XYステージ)の概略構成を示す斜視図である。光源201からの露光用の照明光ILは、均一な照度分布でマスク207を照明する。マスク207上のパターンの投影光学系211を介した像が、フォトリソが塗布された基板252に投影露光される。マスク207はマスクステージRST上に保持され、マスクステージRSTはマスクベースRSB上でスキャン方向であるY方向に例えばリニアモータにより駆動される。Y移動鏡208及び外部のレーザ干渉計209によりマスク207のY座標が計測され、このY座標が装置全体の動作を統轄制御する主制御系210に供給される。主制御系210は、マスクステージ駆動系219を介してマスク207の位置及び移動速度の制御を行う。

【0003】また、後述するリニアモータ駆動XYステージの天板部238の上端に固定されたY軸用の移動鏡250、及び外部のレーザ干渉計246により、感光基板252のY座標が常時モニタされ、検出されたY座標が主制御系210に供給されている。主制御系210は、供給された座標に基づいて駆動系223を介してXリニアモータ224、226及びYリニアモータ232、234の動作を制御する。

【0004】次に、感光基板252を載置して移動する基板ステージ(XYステージ)について図9を用いて説明する。XYステージ200は、定盤212と、定盤212上に固定されたガイドバーとしてのXガイド214と、定盤212上面及びXガイド214に沿ってX方向に移動可能な第1の移動体216と、この第1の移動体216を構成する移動ガイドとしてのYガイド222に沿ってX方向に直交するY方向に移動可能な第2の移動体236とを備えている。Xガイド214は定盤212上のY方向の一端近傍にX方向に沿って配置されている。第1の移動体216は、定盤212上にXガイド214に近接してX方向に沿って配置された第1のYガイド搬送体218と、それと平行に定盤212上に配置された第2のYガイド搬送体220と、それらの間に架設されたY方向に延びるYガイド222とを有している。

【0005】定盤212上のXガイド214のY方向の一側には、第1のXリニアモータ224の固定子224Aが、Xガイド214に近接してX方向に延設されている。また、定盤212上のY方向の他端部近傍で第2のYガイド搬送体220のY方向の他側には、第2のXリニアモータ226の固定子226Aが、X方向に延設されている。第1のXリニアモータ224の可動子224Bは、連結部材228を介してYガイド222の一端に連結されており、第2のXリニアモータ226の可動子226Bは、連結部材230を介してYガイド222の他

端に連結されている。このため、第1、第2のXリニアモータ224、226の可動子224B、226Bの移動によって第1の移動体216がX方向に駆動されるようになっている。

【0006】Yガイド222のX方向の一側と他側には、第1、第2のYリニアモータ232、234の固定子232A、234AがY方向に沿って配置され、第1、第2のYガイド搬送体218、220間に懸架されている。第1、第2のYリニアモータとしてもムービングマグネット型のリニアモータが使用されている。

【0007】第2の移動体236は、Yガイド222を上下から挟む状態で相互に平行にかつ定盤212の上面（基準面）にほぼ平行に配置された天板238及び底板240と、これらの天板238と底板240とをYガイド22の両側で相互に連結する一对のY方向軸受体242、242とを有している。これらのY方向軸受体242、242は、Yガイド222との間に所定のギャップを形成した状態でYガイド222に平行に配置されている。これらのY方向軸受体242、242の外面には、第2の移動体236の駆動手段を構成する前述した第1、第2のYリニアモータ232、234の可動子232B、234B（但し、234Bは図示せず）が取り付けられており、Yリニアモータ232、234の可動子232B、234Bの移動によって第2の移動体236がY方向に駆動されるようになっている。

【0008】天板部238は載物ステージを兼ねており、この天板部238の上面には、定盤212上に固定されたX座標計測用レーザ干渉計244及びY座標計測用レーザ干渉計246から放射されるレーザ光を反射する長尺のX移動鏡248、長尺のY移動鏡250及び感光基板252が搭載されている。第1、第2のXリニアモータ224、226、第1、第2のYリニアモータ232、234が駆動されると、これに応じて感光基板252が搭載された第2の移動体236がX、Y2次元方向に移動し、その移動位置がレーザ干渉計244、246によって計測される。

【0009】

【発明が解決しようとする課題】しかしながら、前記した従来の露光装置においては、ステージ装置の可動部（可動ステージ）に長尺鏡を載置する構成をとる必要があり、可動ステージのストロークを長くするとより長い長尺鏡を可動部に載せることになり、重量・慣性の増大に伴う制御性の劣化、駆動推力の増大をもたらしていた。更に、感光基板252は、今後増々大きくなることが予想され、可動ステージも大型化の一途をたどることが予想される。また従来は、ステージ移動に伴い、ステージ駆動位置（Yリニアモータ232、234の駆動軸の位置）とステージ座標読み取り位置（長尺鏡250へのレーザ干渉計246からの距離計測用レーザ光の入射位置）とが相対的に変化してしまう構成であったため、

機械系のダイナミクスがステージ位置と共に変化し、制御しにくいという問題もあった。そのため、位置決め精度、位置決め時間、等速性能を得るために機械系の剛性や、減衰性能をアップさせる必要があり、高価な材質を使用したり複雑な形状にしなければならず、コストアップを招いていた。

【0010】本発明は、このような従来技術の問題点に鑑み、可動部重量を増加させることなく長いストロークを実現することのできる可動ステージ装置を提供することを目的とする。また、本発明は、ステージが移動してもステージ駆動位置とステージ座標読み取り位置とが相対的に変化せず、高い制御性能と高い位置決め精度が得られるステージ装置を提供することを目的とする。さらに、本発明は、このようなステージ装置を組み込んだ高性能の露光装置を提供することを目的とする。

【0011】

【課題を解決するための手段】上記問題点の解決のために本発明では、長尺鏡を可動しない部分に固定し、ステージ装置の可動部の軽量化を実現するとともに、ステージを駆動する駆動部（アクチュエータ）とレーザ干渉計の読み取りの相対位置がステージ移動によって変わらない構成とした。本発明のステージ装置によると、ステージ位置制御のためのアクチュエータとステージ位置計測のためのレーザ干渉計読み取り位置とが、ステージの位置によらず常に一定となるため、制御コントローラの設計が容易となり、位置決め精度向上に有利である。

【0012】すなわち、本発明によるステージ装置は、第1方向（Y方向）と第2方向（X方向）とに移動可能な可動ステージ（PST）と、ベース部材（19）に設けられた長尺鏡（75、77）に対する前記可動ステージ（PST）の位置を検出する位置検出装置とを備えたステージ装置（13、15）において、長尺鏡（75、77）に対する可動ステージ（PST）の位置を検出する検出光（L1、L2、L3）を可動ステージに設けられた光学装置（干渉計ユニット）（81、82、83；121、122、123）を介して長尺鏡（75、77）に送光する送光光学系（91、92、93；131、132、133）と、可動ステージ（PST、RST）の第1方向の移動に応じて、前記送光光学系（91、92、93；131、132、133）を前記第1方向（Y方向）に移動させる移動装置（72、102）とを備えたことを特徴とする。

【0013】ベース部材（19）は可動ステージ（PST）を移動可能に支持している。移動装置（72、102）は可動ステージ（PST）を前記第1方向（Y方向）に移動させるものとして行うことができる。また、可動ステージ（PST）を第2方向（X方向）に移動させるステージ移動装置を備える。可動ステージ（PST）を第2方向（X方向）に移動させるステージ移動装置が可動ステージ（PST）を移動させる移動軸と、可動ス

ージ(PST)に設けられた光学装置(干渉計ユニット)(81, 82, 83; 121, 122, 123)と長尺鏡(75, 77)の間の光軸とはほぼ一致していることが好ましい。

【0014】位置検出装置は、ベース部材(19)とは振動的に分離した振動分離部材(79)に配置された検出器(干渉計レシーバ78)を備えている。本発明による露光装置は、マスクステージ(RST)に保持されたマス(R)のパターンを基板ステージ(PST)に保持された基板(P)に露光する露光装置(11)において、マスクステージ(RST)と基板ステージ(PST)との少なくとも一方のステージとして、前述のステージ装置を用いたことを特徴とする。この露光装置(11)は、マスク(R)のパターンを基板(P)に投影する投影光学系(PL)を備えるものとする。投影光学系(PL)と長尺鏡(75, 77)とは共通の部材により保持することができる。また、長尺鏡を投影光学系と一体化された部材に構成してもよい。

【0015】

【発明の実施の形態】以下、図面を参照して本発明の実施の形態を説明する。ここでは、本発明のステージ装置を、マスクとしてのレチクルのパターンを角形のガラス基板に露光するステップ・アンド・スキャン方式の露光装置に適用する場合の例を用いて説明する。この露光装置においては、本発明のステージ装置をマスクを保持して移動するマスクステージ及びガラス基板を保持して移動する基板ステージの両方に適用するものとする。

【0016】図1は、本発明による露光装置11の一例を示す概略図である。この露光装置11は、照明光学系12、マスクRを保持して移動するマスクステージ装置(ステージ装置)13、投影光学系PL、投影光学系PLを保持する本体コラム14、ガラス基板Pを保持して移動する基板ステージ装置(ステージ装置)15等を備えている。なお、本実施の形態では、一例として800×950mmの大型のガラス基板Pに液晶表示素子パターンを露光するものとする。

【0017】照明光学系12は、例えば特開平9-320956号公報に開示されているように、光源ユニット、シャッタ、2次光源形成光学系、ビームスプリッタ、集光レンズ系、マスクブラインド、及び結像レンズ系(いずれも不図示)から構成され、マスクステージ装置13に保持されたマスクR上の矩形(あるいは円弧状)の照明領域を照明光ILにより均一な照度で照明する。

【0018】本体コラム14は、設置床FDの上面に載置された装置の基準となるベースプレートBPの上面に複数(ここでは4つ、ただし図1では前面側の2つのみ図示)の防振台16を介して保持された第1コラム17と、この第1コラム17上に設けられた第2コラム18とから構成されている。この防振台16は、ダンピング

材としてゴム等の弾性材を用いたパッシブ型のものが配置されている。

【0019】第1コラム17は、4つの防振台16によってほぼ水平に支持され、基板ステージ装置15を構成する矩形のベース19と、このベース19の上面の4隅の部分に鉛直方向に沿ってそれぞれ配設された4本の脚部20と、これら4本の脚部20の上端部を相互に連結すると共に第1コラム17の天板部を構成する境筒定盤21とを備えている。ベース19は石定盤から構成されている。この石定盤にセラミックを溶射してコートすれば石定盤の欠けによる面精度の劣化を防ぐことができる。この境筒定盤21の中央部には、平面視円形の開口部21Aが形成され、この開口部21A内に投影光学系PLが上方から挿入されている。この投影光学系PLには、その高さ方向の中央やや下方の位置にフランジFLが設けられており、フランジFLを介して投影光学系PLが境筒定盤21によって下方から支持されている。

【0020】第2コラム18は、境筒定盤21の上面に投影光学系PLを囲むように立設された4本の脚部22と、これら4本の脚部22の上端部相互間を連結する天板部、すなわちマスクステージ装置13を構成するベース23とを備えている。ベース23の中央部には、照明光ILの通路となる開口23Aが形成されている。なお、ベース23の全体又は一部(開口23Aに相当する部分)を光透過性材料により形成してもよい。このようにして構成された本体コラム14に対する設置床FDからの振動は、防振台16によってマイクロGレベルで絶縁されている。

【0021】投影光学系PLとしては、その光軸AXの方向がZ軸方向とされ、ここでは、両側テレセントリックな光学配置となるように光軸AX方向に沿って所定間隔で配置された複数枚のレンズエレメントからなる屈折光学系が使用されている。この投影光学系PLは、所定の投影倍率、例えば等倍を有している。このため、照明光学系12からの照明光ILによってマスクRの照明領域が照明されると、マスクRを通過した照明光により、投影光学系PLを介してマスクR上の照明領域部分のパターンの等倍正立像が、表面にフォトリソが塗布されたガラス基板P上の前記照明領域に共役な露光領域に露光される。

【0022】図2は、基板ステージ装置15の外観斜視図である。この基板ステージ装置15は、ベース19と、ベース19の上方に非接触で浮上支持された基板ステージ(ステージ本体)PSTと、基板ステージPSTを走査方向であるX軸方向に駆動するリニアモータとしてのXリニアモータ64と、基板ステージPSTをステップ移動方向であるY軸方向に駆動するリニアモータとしてのYリニアモータ65A, 65Bと、Yリニアモータ65A, 65Bによる基板ステージPSTの駆動に伴

って生じる反力を受ける反力遮断用フレーム54, 55とから構成されている。反力遮断用フレーム54, 55は、一端が床面FDに固定された支持部材62に支持されることにより、ベース19に対して振動的に独立して設置されている。この反力遮断用フレーム54, 55により、基板ステージPSTがY方向に駆動した際に発生する反力が床に伝達されるので、投影光学系PLにこの反力が伝わることはない。

【0023】Xリニアモータ64は、X軸方向に沿って延設された固定子66A, 66Bと、基板ステージPSTが固定され固定子66に対して相対移動する可動子としてのXキャリッジ67とから構成されている。固定子66A, 66Bは、X軸方向に沿って延設されたXガイド68の上部に設けられている。そして、Xキャリッジ67には、Xガイド68を挟んで可動部材69がXキャリッジ67と一体的に、かつXガイド68に対して移動自在に設けられている。また、可動部材69は、底面側に例えばセラミック製のエアパッド70（エアベアリング）が配設されて、ベース19に対して浮上支持されている。基板ステージPSTの上面には、不図示の基板ホルダを介してガラス基板Pが真空吸着等により保持される。

【0024】Yリニアモータ65Aは、Yガイド68の-X側端部に設けられた可動子57Aと、反力遮断用フレーム54上に支持される固定子59Aとから構成されている。また、Yリニアモータ65Bは、Y軸方向に沿って延設されたYガイド71に沿って移動自在なYキャリッジ72の+X側端部に設けられた可動子57Bと、反力遮断用フレーム55上に支持される固定子59Bとから構成されている。各固定子59A, 59Bは、可動子57A, 57Bを挟み込むように基板ステージPSTに向けて開口するコ字状を呈している。なお、Yキャリッジ72の-X側端部には、Xガイド68が固定されている。

【0025】基板ステージPSTのX, Y方向の座標位置計測はレーザ干渉計を用いて行われる。基板ステージPSTのX方向の座標位置計測のために、ベース19上に支持部材74を介してレーザ干渉計用の長尺鏡75を固定し、基板ステージPST上にコーナキューブと平面鏡を対とした干渉計ユニット81, 82を配置してある。また、基板ステージPSTのY方向の座標位置計測のために、ベース19上に支持部材76を介してレーザ干渉計用の長尺鏡77を固定し、基板ステージPST上にコーナキューブと平面鏡を対とした干渉計83を配置してある。レーザ干渉計ユニット81, 82, 83用のレーザ光源及び受光器を収容した干渉計レシーバ78は、一端が床面FDに固定された支持部材79に支持することにより、ベース19に対して振動的に独立して設置されている。干渉計レシーバ78は可動する必要がないため、従来同様、装置より離れたところに設置するこ

とができるため、レシーバの発熱影響はなく、配線を引き回す必要もない。また、Yキャリッジ72上に干渉計バスを構成する光路折り曲げ用の反射鏡91, 92, 93が設置されている。

【0026】図3は、本発明によるレーザ干渉計の構成を説明するための概略平面図である。基板ステージPST上には、基板ステージPSTのX方向の座標位置計測のための2個の干渉計ユニット81, 82と、基板ステージPSTのY方向の座標位置計測用の1個の干渉計ユニット83が設置されている。また、干渉計バスを構成する反射鏡91～93がYガイド71に沿ってY方向に移動するYキャリッジ72上に配置されている。干渉計レシーバ78中のレーザ光源から出射された計測用のレーザ光L1は、Yキャリッジ72上の反射鏡91で反射されて干渉計ユニット81に入射し、干渉計ユニットの基準鏡で反射されたレーザ光とベース19に対して固定された長尺鏡75で反射されたレーザ光とが干渉計ユニット81にて光干渉して発生した干渉光は、干渉計ユニット81から出射したのち入射レーザ光L1と逆方向に進行し、Yキャリッジ72上の反射鏡91で反射されて干渉計レシーバ78に戻る。

【0027】同様に、干渉計レシーバ78中のレーザ光源から出射されたレーザ光L2は、Yキャリッジ72上の反射鏡92で反射されて干渉計ユニット82に入射し、干渉計ユニットの基準鏡で反射されたレーザ光とベース19に対して固定された長尺鏡75で反射されたレーザ光とが干渉計ユニット82にて光干渉し、干渉光は干渉計ユニット81から出射したのち入射レーザ光L2と逆方向に進行し、Yキャリッジ72上の反射鏡92で反射されて干渉計レシーバ78に戻る。また、干渉計レシーバ78中のレーザ光源から出射されたレーザ光L3は、Yキャリッジ72上の反射鏡93で反射されて干渉計ユニット83に入射し、干渉計ユニット83の基準鏡で反射されたレーザ光とベース19に対して固定された長尺鏡77で反射されたレーザ光との干渉によって発生した干渉光は、入射レーザ光L3と逆方向に進行し、Yキャリッジ72上の反射鏡93で反射されて干渉計レシーバ78に戻る。

【0028】このようにYガイド71に沿って基板ステージPSTと共にY方向に移動するYキャリッジ72上に配置した反射鏡91, 92, 93から干渉計ユニット81, 82, 83にレーザ光を入射させることにより、Y方向に基板ステージPSTが移動しても基板ステージPST上の干渉計ユニット81, 82, 83に正確にレーザ光を入射することができる。また、干渉計ユニット81, 82, 83を出射した干渉光は入射光路を逆行して干渉計レシーバ78に戻っていく。レーザ干渉計によって干渉計測する箇所は、基板ステージPST上の干渉計ユニット81, 82と長尺鏡75との間の間隔、及び干渉計ユニット83と長尺鏡77との間の距離である。

そのため、Yキャリッジ72上に干渉計バスを構成する光学系の一部を載せているが、その部分の真直性が悪くても、計測誤差が発生することはない。

【0029】長尺鏡75は基板ステージPSTと共に移動する干渉計ユニット81、82のY方向の移動ストロークをカバーする長さを有し、長尺鏡77は同様に基板ステージPSTに乗って移動する干渉計ユニット83のX方向の移動ストロークをカバーする長さを有する。また、干渉計ユニット81と長尺鏡75の間を往復するレーザ光の光路は、Xリニアモータ64のX軸方向に沿って延設された固定子66A上に設定されている。つまり、干渉計ユニット81は、Xリニアモータ64の駆動力が作用する位置において、基板ステージPSTと長尺鏡75との間の距離を計測する。同様に、干渉計ユニット82と長尺鏡75の間を往復するレーザ光の光路はXリニアモータ64のX軸方向に沿って延設された固定子66B上に設定され、干渉計ユニット81は、Xリニアモータ64の駆動力が作用する位置において、基板ステージPSTと長尺鏡75との間の距離を計測する。

【0030】図4は、干渉計ユニットの構造を説明する概略図である。ここでは干渉計ユニット81を例にとって説明するが、他の干渉計ユニット82、83も同様の構造を有する。干渉計ユニット81は、偏光ビームスプリッタ95、基準鏡96、コーナーキューブ97、及び4分の1波長板98、99から構成されている。

【0031】Yキャリッジ72上の反射鏡91で反射されたレーザ光L1は、干渉計ユニット81の偏光ビームスプリッタ95に入射し、偏光ビームスプリッタ95で透過光成分1と反射光成分2に分割される。反射光成分1は4分の1波長板98を通して基準鏡96で反射され、再び4分の1波長板98を通して偏光方向が90°回転し、偏光ビームスプリッタ95で今度は反射されてコーナーキューブ97に入射する。コーナーキューブ97から戻ってきたレーザ光は再び偏光ビームスプリッタ95で反射され、光路3を進んで基準鏡96に入射する。基準鏡で反射されたレーザ光は、そのまま偏光ビームスプリッタ95を透過して干渉計ユニット81から出射する。

【0032】一方、反射光成分2は4分の1波長板99を通して長尺鏡75で反射され、再び4分の1波長板99を通して偏光方向が90°回転し、偏光ビームスプリッタ95を透過してコーナーキューブ97に入射する。コーナーキューブ97から戻ってきた光は再び偏光ビームスプリッタ95を透過し、光路4を進んで長尺鏡75に入射する。長尺鏡で反射されたレーザ光は偏光ビームスプリッタ95で反射され、干渉計ユニット81から出射する。

【0033】こうして、基準鏡96との間を2往復したレーザ光と長尺鏡75との間を2往復したレーザ光との干渉光が干渉計ユニット81から出射され、Yキャリッ

ジ72上の反射鏡91で反射された後、干渉計レシーバ78に入射し、検出される。偏光ビームスプリッタ95と基準鏡96との間の距離は不変である。一方、偏光ビームスプリッタ95と長尺鏡75との間の距離は基板ステージPSTの移動によって変化し、干渉計ユニット81から出射する干渉光の干渉状態は干渉計ユニット81と長尺鏡75との距離を反映したものとなり、干渉計レシーバ78は干渉縞の変化から干渉計ユニット81と長尺鏡75との距離を計測する。図示の例では、干渉計ユニット81による距離計測値と干渉計ユニット82による距離計測値の平均をとることで基板ステージPSTのX方向座標を求め、干渉計ユニット81と干渉計ユニット82による距離計測値の差を両干渉計ユニット81、82のY方向距離で除算して基板ステージPSTの回転角を計測する。また、干渉計ユニット83を用いた距離計測値から基板ステージPSTのY方向座標を求める。

【0034】図1に戻り、マスクステージ装置13は、前記ベース23と、ベース23の上方に非接触で浮上支持されたマスクステージ（ステージ本体）RSTと、マスクステージRSTを走査方向（相対移動方向）であるY軸方向に所定のストロークで駆動するとともに、Y軸方向に直交するX軸方向に微小駆動するマスク駆動系24と、このマスク駆動系によるマスクステージRSTの駆動に伴って生じる反力を受ける反力遮断用フレーム（支持部）25、26とを備えている。反力遮断用フレーム25、26の基端は、図1に示される境筒定盤21、ベース19、及びベースプレートBPにそれぞれ形成された開口部を介して床面FDに固定されており、マスクステージRSTの移動により発生する反力を床に逃がすものである。この反力遮断用フレーム25、26により前述の反力が投影光学系PLに伝達されることがない。このため、精度の高い露光を実現することができる。

【0035】マスクステージ装置13の駆動系は基板ステージPSTの駆動系と同様の構造を有し、レーザ干渉計を用いたマスクステージRSTの座標位置検出装置も基板ステージPSTの座標位置検出装置と同様の構成を有する。なお、上記の実施の形態では、固定子がステージへ向けて開口するコ字状を呈する構成としたが、例えば図5に示すように、固定子59A、59Bが+Z方向へ向けて開口する構成であってもよい。この場合、可動子は固定子内へ向けて-Z方向へ垂下する形状にすればよい。また、上記のリニアモータであるYリニアモータ64及びXリニアモータ65A、65Bは、ムービングコイル型、ムービングマグネット型のどちらの形式も適用可能である。

【0036】また、本発明は、リニアモータ以外の駆動装置によって駆動されるステージ装置に対しても適用可能である。図6はボールネジによって駆動される基板ステージ装置に本発明を適用した例を示す概略斜視図であ

り、図7はその概略平面図である。

【0037】この基板ステージ装置は、ベース19と、ベース19の上方に位置する基板ステージPSTと、基板ステージPSTを駆動するための機構を備える。駆動機構は、ボールネジ114及びそれを回転駆動するXモータ113と、ボールネジ104及びそれを回転駆動するYモータ103とを備える。基板ステージPSTの上面には、不図示の基板ホルダを介してガラス基板Pが真空吸着等により保持される。Yモータ103は、Yガイド101に沿ってYキャリッジ102を駆動する。Yキャリッジ102の-X側端部には、Xガイド111が固定されている。基板ステージPSTは、Yモータ103を駆動することによりYキャリッジ102と共にY方向に移動し、Xモータ113を駆動することによりXガイド111に沿ってX方向に移動する。

【0038】基板ステージPSTのX、Y方向の座標位置計測は前記したステージ装置と同様にレーザ干渉計を用いて行われる。基板ステージPSTのX方向の座標位置計測のために、ベース19上に支持部材74を介してレーザ干渉計用の長尺鏡75を固定し、基板ステージPST上にコーナキューブと平面鏡を対とした干渉計ユニット121、122を配置してある。また、基板ステージPSTのY方向の座標位置計測のために、ベース19上に支持部材76を介してレーザ干渉計用の長尺鏡77を固定し、基板ステージPST上にコーナキューブと平面鏡を対とした干渉計123を配置してある。また、Yキャリッジ102上に干渉計バスを構成する光路折り曲げ用の反射鏡131、132、133が設置されている。

【0039】干渉計ユニット122と長尺鏡75の間を往復するレーザ光の光路は、Xモータ113による駆動力が基板ステージPSTに作用する位置、すなわちボールネジ114上に設定されている。こうして、干渉計ユニット122は、Xモータ113の駆動力が作用する位置において、基板ステージPSTと長尺鏡75との間の距離を計測する。干渉計ユニット122による距離計測値によって基板ステージPSTのX方向座標を求め、干渉計ユニット121と干渉計ユニット122による距離計測値の差を両干渉計ユニット121、122のY方向距離で除算して基板ステージPSTの回転角を計測する。また、干渉計ユニット123を用いた距離計測値から基板ステージPSTのY方向座標を求める。

【0040】本発明によると、駆動用アクチュエータと可動部位置を計測するレーザ干渉計との相対位置が変化しないため、ステージ可動部がX、Y座標系のどの位置にあっても制御系の周波数応答が変化しない。そのため制御コントローラによるフィルタリングが可能となり、さらに高い制御性能が得られる。

【0041】また、今まで長尺鏡面の精度を維持するため、長尺鏡を取付ける部材の面に高い平面度が要求され

それを維持するため剛性が必要となり、どうしても分厚く重い部品とならざるを得なかった。しかし、本発明では長尺鏡を固定側にもってこることが可能であるため、長尺鏡本体の重量だけでなく、支持する部材の重量までも考慮することなく構成できる。そのため、平面度をまったく損なうことなく長尺鏡を組み込むことができるようになった。

【0042】本発明による干渉計構成は、アッペ誤差を生じることが懸念される。特に、露光中に動かない投影光学系PLを基準とした場合においては、位置計測を行うレーザ光側が動くことになるので、レーザ光と投影光学系PLとの間隔(Δx 又は Δy)に比例した誤差が生じることになる。しかし、可動部(基板ステージPST、マスクステージRST)のX方向、Y方向、 θ 方向のすべての変位をモニターしているので、その場合であっても、X方向の誤差を $\Delta y \cdot \Delta \theta$ としてY方向の誤差を $\Delta x \cdot \Delta \theta$ として補正をかけることでアッペ誤差をキャンセルさせることができる。

【0043】上記実施の形態では、本発明のステージ装置を露光装置11に適用する構成としたが、これに限定されるものではなく、露光装置11以外にも転写マスクの描画装置、マスクパターンの位置座標測定装置等の精密測定機器にも適用可能である。基板としては、液晶表示デバイス用のガラス基板Pのみならず、半導体デバイス用の半導体ウエハや、薄膜磁気ヘッド用のセラミックウエハ、あるいは露光装置で用いられるマスクまたはマスクの原版(合成石英、シリコンウエハ)等が適用される。

【0044】露光装置11としては、レテクルRとガラス基板Pとを同期移動してマスクRのパターンを走査露光するステップ・アンド・スキャン方式の走査型露光装置(スキニング・ステッパー; 米国特許第5,473,410号)の他に、マスクRとガラス基板Pとを静止した状態でマスクRのパターンを露光し、ガラス基板Pを順次ステップ移動させるステップ・アンド・リピート方式の投影露光装置(ステッパー)にも適用することができる。露光装置11の種類としては、液晶表示デバイス製造用の露光装置に限られず、ウエハに半導体デバイスパターンを露光する半導体デバイス製造用の露光装置や、薄膜磁気ヘッド、撮像素子(CCD)あるいはマスクなどを製造するための露光装置などにも広く適用できる。

【0045】また、露光用照明光の光源として、超高圧水銀ランプから発生する輝線(g線(436nm)、h線(404.7nm)、i線(365nm))、KrFエキシマレーザ(248nm)、ArFエキシマレーザ(193nm)、F₂レーザ(157nm)のみならず、X線や電子線などの荷電粒子線を用いることができる。例えば、電子線を用いる場合には電子銃として、熱電子放射型のランタンヘキサボライト(LaB₆)、タ

ンタル (Ta) を用いることができる。さらに、電子線を用いる場合は、マスクRを用いる構成としてもよいし、マスクRを用いずに直接ウエハ上にパターンを形成する構成としてもよい。また、YAGレーザや半導体レーザ等の高調波などを用いてもよい。

【0046】投影光学系PLの倍率は、等倍系のみならず縮小系および拡大系のいずれでもよい。また、投影光学系PLとしては、エキシマレーザなどの遠紫外線を用いる場合は硝材として石英や蛍石などの遠紫外線を透過する材料を用い、F₂レーザやX線を用いる場合は反射屈折系または屈折系の光学系にし（マスクRも反射型タイプのものを用いる）、また電子線を用いる場合には光学系として電子レンズおよび偏向器からなる電子光学系を用いればよい。なお、電子線が通過する光路は真空状態にすることはいうまでもない。また、投影光学系PLを用いることなく、マスクRとウエハWとを密接させてマスクRのパターンを露光するプロキシミティ露光装置にも適用可能である。

【0047】各ステージRST, PSTの駆動機構としては、二次元に磁石を配置した磁石ユニット（永久磁石）と、二次元にコイルを配置した電機子ユニットとを対向させ電磁力により各ステージRST, PSTを駆動する平面モータを用いてもよい。この場合、磁石ユニットと電機子ユニットとのいずれか一方をステージRST, PSTに接続し、磁石ユニットと電機子ユニットの他方をステージRST, PSTの移動両側（ベース）に設ければよい。

【0048】

【発明の効果】以上のように本発明によれば、精度を要する長尺鏡を可動部に構成する必要がないため、長尺鏡重量だけでなくそれを精度良く締結する部材も省略でき、可動部重量を大幅に軽減できる。そのため、機械系の共振周波数が高まり制御系の周波数応答が高くとり、制御性能を向上させることができる。

【図面の簡単な説明】

【図1】本発明による露光装置の一例を示す概略図。

【図2】基板ステージ装置の外観斜視図。

【図3】本発明によるレーザ干渉計の構成を説明するための概略平面図。

【図4】干渉計ユニットの構造を説明する概略図。

【図5】本発明による基板ステージ装置の他の例を示す

概略図。

【図6】本発明による基板ステージ装置の他の例を示す概略図。

【図7】図7に示した基板ステージ装置の概略平面図。

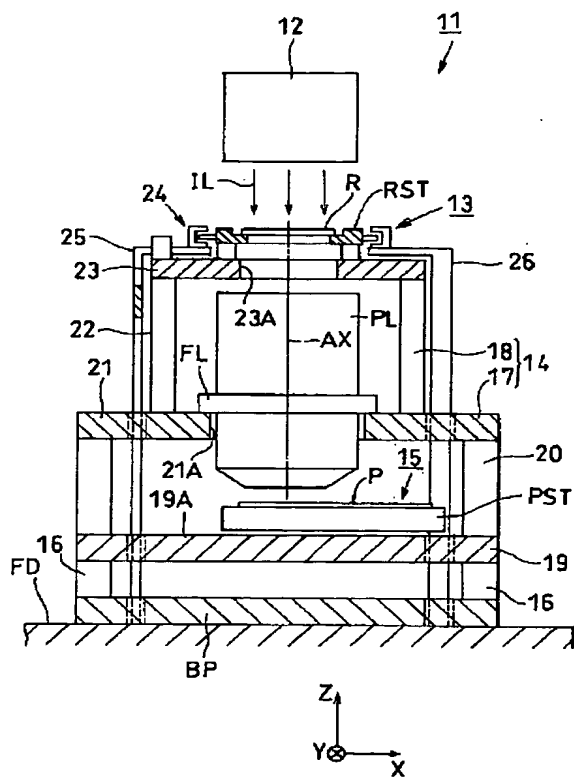
【図8】従来のステップ・アンド・スキャン方式の走査型露光装置の概略図。

【図9】従来の基板ステージの概略構成を示す斜視図。

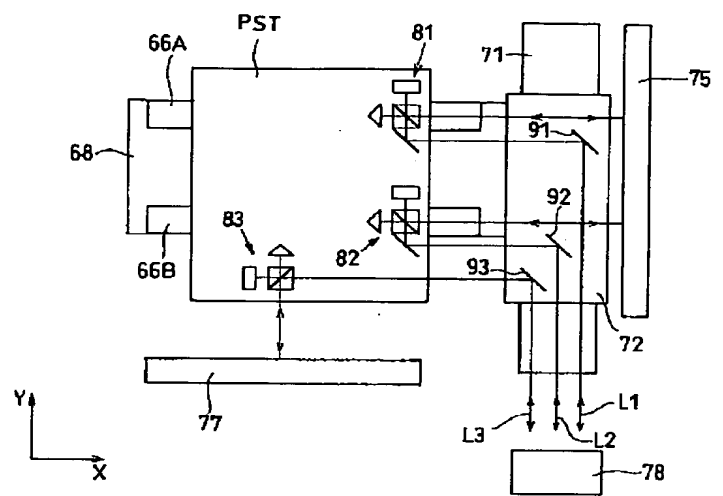
【符号の説明】

11…露光装置、12…照明光学系、13…マスクステージ装置、14…本体コラム、15…基板ステージ装置、16…防振台、19…ベース、20…脚部、21…境筒定盤、22…脚部、23…ベース、24…マスク駆動系、25、26…反力遮断用フレーム、54、55…反力遮断用フレーム、57A、57B…可動子、59A、59B…固定子、62…支持部材、64…Xリニアモータ、65A、65B…Yリニアモータ、66A、66B…固定子、67…Xキャリッジ、68…Xガイド、70…エアパッド、71…Yガイド、72…Yキャリッジ、74…支持部材、75…長尺鏡、76…支持部材、77…長尺鏡、78…干渉計レシーバ、79…支持部材、81、82、83…干渉計ユニット、91、92、93…反射鏡、95…偏光ビームスプリッタ、96…基準鏡、97…コーナーキューブ、98、99…4分の1波長板、101…Yガイド、102…Yキャリッジ、103…Yモータ、104…ボールネジ、111…Xガイド、113…Xモータ、114…ボールネジ、121、122、123…干渉計ユニット、131、132、133…反射鏡、200…XYステージ、201…光源系、207…マスク、210…主制御系、211…投影光学系、212…定盤、214…Xガイド、216…第1の移動体、218、220…Yガイド搬送体、219…レチクルステージ駆動系、222…Yガイド、223…駆動系、224、226…Xリニアモータ、228…連結部材、232、234…Yリニアモータ、236…載物ステージ（第2の移動体）、242…Y方向軸受、246…レーザ干渉計、250…Y移動鏡、252…感光基板、BP…ベースプレート、FD…設置床、IL…照明光、L1、L2、L3…計測用レーザ光、P…ガラス基板、PL…投影光学系、PST…基板ステージ、R…マスク、RST…マスクステージ

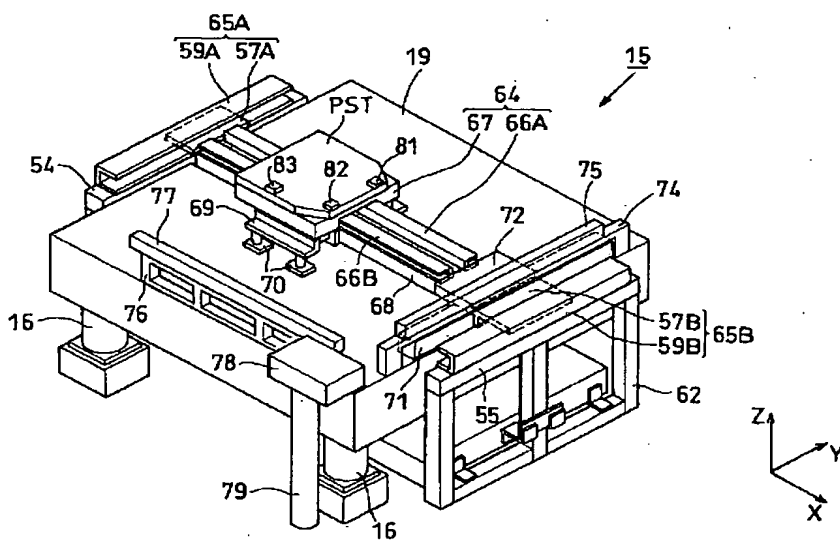
【図 1】



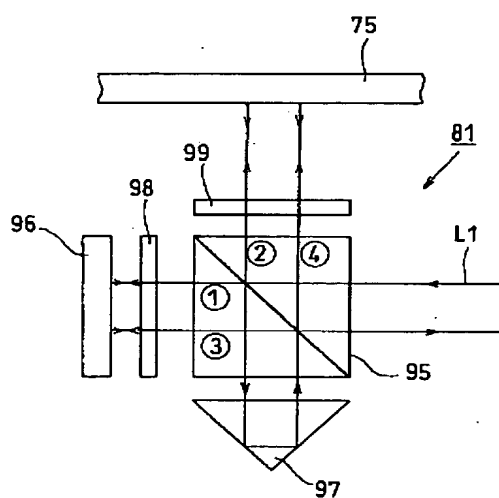
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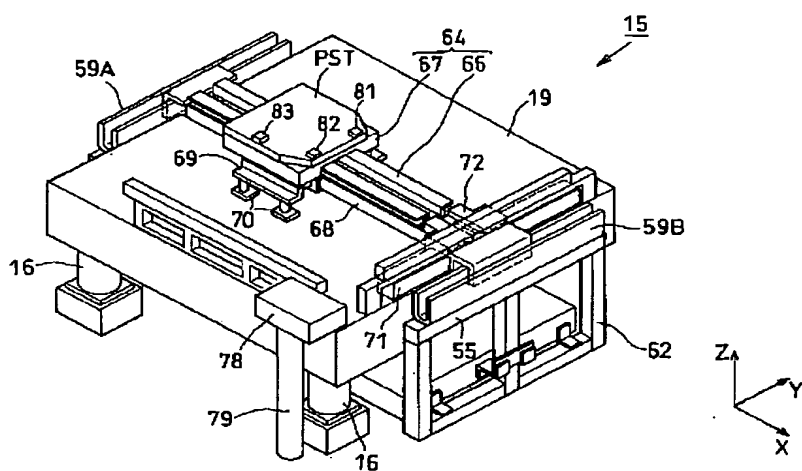
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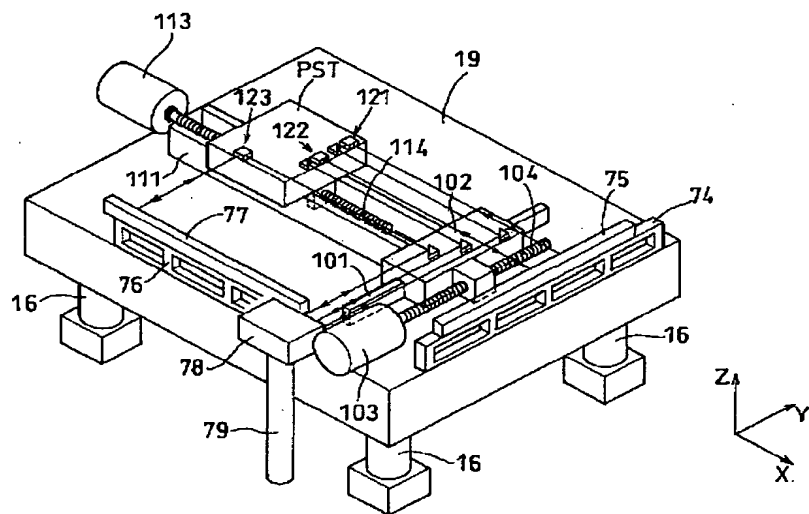
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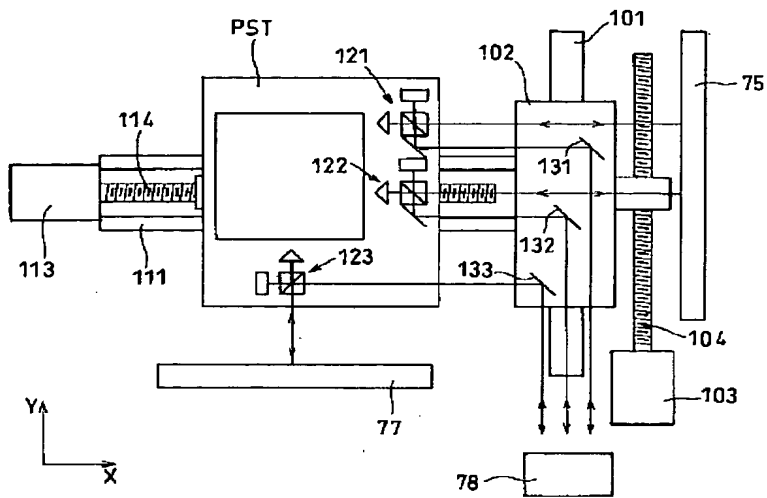
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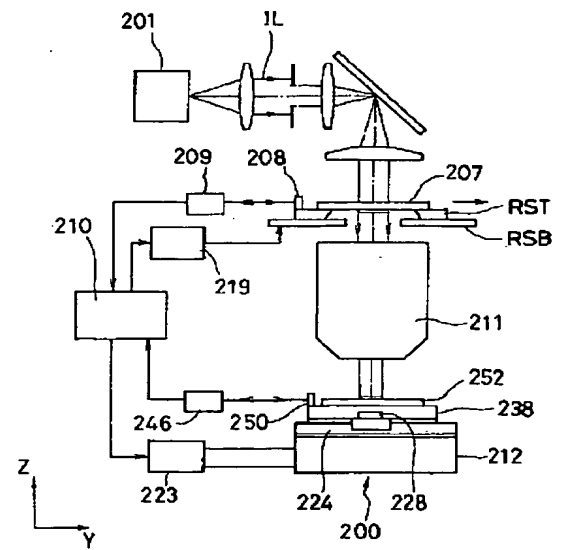
【図6】



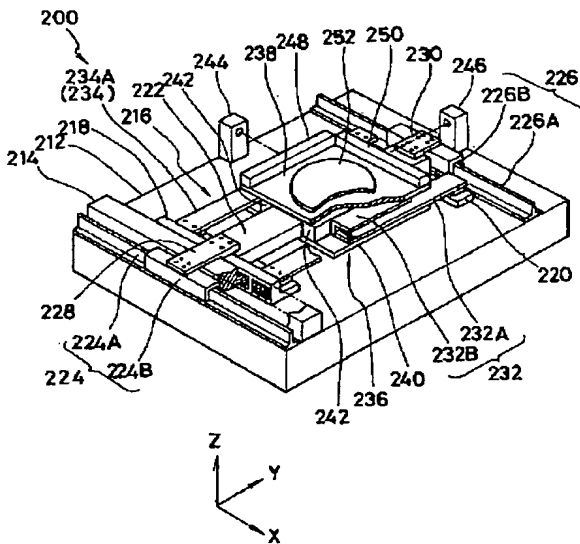
【図7】



【図8】



【図9】



フロントページの続き

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CC18 DB05 DC05 DC12 GA06
GA11 GA12 GA14
5F056 CB22 CC05 EA14 FA06

*** NOTICES ***

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Begin Translation:

CLAIMS

CLAIMS

[Claim(s)]

[Claim 1] Stage equipment equipped with the position detection equipment which is characterized by providing the following and which detects the position of a movable stage movable in the 1st direction and the 2nd direction, and the aforementioned movable stage to the long mirror formed in the base member. Light transmission optical system which carries out light transmission of the detection light which detects the position of the aforementioned movable stage to the aforementioned long mirror to the aforementioned long mirror through the optical equipment in which it was prepared on the aforementioned movable stage. Move equipment made to move the aforementioned light transmission optical system in the 1st direction of the above according to movement of the 1st direction of the above of the aforementioned movable stage.

[Claim 2] It is stage equipment characterized by the aforementioned base member supporting the aforementioned movable stage possible [movement] in stage equipment according to claim 1.

[Claim 3] It is stage equipment characterized by the aforementioned move equipment moving the aforementioned movable stage in the 1st direction of the above in stage equipment according to claim 1 or 2.

[Claim 4] Stage equipment characterized by having stage move equipment made to move in the 2nd direction of the above on the aforementioned movable stage in the stage equipment of a claim 1-3 given in any 1 term.

[Claim 5] The move shaft to which the aforementioned stage move equipment moves the aforementioned movable stage in stage equipment according to claim 4, and the aforementioned optical equipment with which it was prepared in the aforementioned movable stage and the optical axis between the aforementioned long mirrors are stage equipment with which it is characterized by carrying out simultaneously coincidence.

[Claim 6] It is stage equipment characterized by having the detector arranged at the vibration separation member which separated the aforementioned position detection equipment in [the aforementioned base member] vibration in the stage equipment of a claim 1-5 given in any 1 term.

[Claim 7] The aligner characterized by using the stage equipment of six given in any 1 term

from a claim 1 as one [at least] stage of the aforementioned mask stage and the aforementioned substrate stage in the aligner which exposes the pattern of the mask held at the mask stage to the substrate held on the substrate stage.

[Claim 8] The aligner characterized by having the projection optical system which projects the pattern of the aforementioned mask on the aforementioned substrate in an aligner according to claim 7.

[Claim 9] It is the aligner characterized by being held in an aligner according to claim 8 by the member with common aforementioned projection optical system and aforementioned long mirror.

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[The technical field to which invention belongs] this invention relates to the stage equipment built into the aligner which exposes a pattern to a substrate by the manufacturing process of a semiconductor device or a liquid crystal display panel, and its aligner.

[0002]

[Description of the Prior Art] Step [of the former / drawing 8] - and the schematic diagram of the scanned type aligner of - scanning method, and drawing 9 are the perspective diagrams showing the outline composition of the substrate stage (X-Y stage). The lighting light IL for the exposure from the light source 201 illuminates a mask 207 by the uniform illumination distribution. Projection exposure of the image through the projection optical system 211 of the pattern on a mask 207 is carried out at the substrate 252 to which the photoresist was applied. A mask 207 is held on a mask stage RST, and a mask stage RST drives it by the linear motor in the direction of Y which is the direction of a scan on the mask base RSB. The Y coordinate of a mask 207 is measured by Y move mirror 208 and the external laser interferometer 209, and the main-control system 210 to which this Y coordinate carries out control control of the operation of the whole equipment is supplied. The main-control system 210 performs the position of a mask 207, and control of traverse speed through the mask-stage drive system 219.

[0003] Moreover, by the move mirror 250 for Y-axes fixed to the upper limit of the top-plate section 238 of the linear motor drive X-Y stage mentioned later, and the external laser interferometer 246, the monitor of the Y coordinate of the sensitization substrate 252 is always carried out, and the detected Y coordinate is supplied to the main-control system 210. The main-control system 210 controls operation of the X linear motor 224,226 and the Y linear motor 232,234 through a drive system 223 based on the supplied coordinate.

[0004] Next, the sensitization substrate 252 is explained using drawing 9 about the substrate stage (X-Y stage) where it lays and moves. X-Y stage 200 is equipped with the 1st mobile 216 which can move in the direction of X, and the 2nd mobile 236 which can move in the direction of Y which intersects perpendicularly in the direction of X along with the Y guide 222 as a move guide which constitutes this 1st mobile 216 along with the X guide 214, and the surface plate 212 upper surface and the X guide 214 as a guide bar fixed on the surface plate 212 and the surface plate 212. The X guide 214 is arranged along the direction of X near the end side of the direction of Y on a surface plate 212. The 1st mobile 216 has 1st Y guide conveyance object 218 which approached the X guide 214 on the surface plate 212, and has been arranged along the direction of X, it and 2nd Y guide conveyance object 220 arranged on a surface plate 212 at parallel, and the Y guide 222 prolonged in the direction of Y constructed among them.

[0005] Stator 224A of the 1st X linear motor 224 approaches the X guide 214, and is

installed in the direction of X by the unilateral of the direction of Y of the X guide 214 on a surface plate 212. Moreover, stator 226A of the 2nd X linear motor 226 is installed in the direction of X near the other end of the direction of Y on a surface plate 212 at the side besides the direction of Y of 2nd Y guide conveyance object 220. needle 224B of the 1st X linear motor 224 -- connection -- it connects with the end of the Y guide 222 through a member 228 -- having -- **** -- needle 226B of the 2nd X linear motor 226 -- connection - - it connects with the other end of the Y guide 22 through the member 230 For this reason, the 1st mobile 216 drives in the direction of X by movement of the needles 224B and 226B of the 1st and 2nd X linear motor 224,226.

[0006] The stators 232A and 234A of the 1st and 2nd Y linear motor 232,234 are arranged along the direction of Y, and suspension is carried out to the unilateral of the direction of X of the Y guide 222, and the side else between the 1st and 2nd Y guide conveyance object 218,220. The linear motor of the MUBINGU magnet type also as the 1st and 2nd Y linear motor is used.

[0007] The 2nd mobile 236 has Y directional-axis acceptor 242,242 of the couple which connects mutually the top plates 238 and bottom plates 240 which have been mostly arranged in parallel with mutual on the upper surface (datum level) of a surface plate 212 at parallel in the state of pinching the Y guide 222 from the upper and lower sides, and these top plates 238 and bottom plates 240 on both sides of the Y guide 22. These Y directional-axis acceptors 242,242 are arranged in parallel with the Y guide 222, where a predetermined gap is formed between the Y guides 222. The needles 232B and 234B (however, 234B is not shown) of the 1st and 2nd Y linear motor 232,234 which constitute the driving means of the 2nd mobile 236 and which were mentioned above are attached in the superficies of these Y directional-axis acceptors 242,242, and the 2nd mobile 236 drives in the direction of Y by movement of the needles 232B and 234B of the Y linear motor 232,234.

[0008] The top-plate section 238 serves as the **** stage, and long X move mirror 248 which reflects the laser beam emitted from the laser interferometer 244 for X coordinate measurement and the laser interferometer 246 for Y coordinate measurement which were fixed on the surface plate 212, long Y move mirror 250, and the sensitization substrate 252 are carried in the upper surface of this top-plate section 238. If the 1st, the 2nd X linear motor 224,226, the 1st, and 2nd Y linear motor 232,234 drives, the 2nd mobile 236 in which the sensitization substrate 252 was carried according to this will move in X and the Y two-dimensional direction, and the move position will be measured by the laser interferometer 244,246.

[0009]

[Problem(s) to be Solved by the Invention] However, in said conventional aligner, the composition which lays a long mirror in the moving part (movable stage) of stage equipment needed to be taken, when the stroke of a movable stage was lengthened, a long longer mirror will be put on moving part, and degradation of the controllability accompanying increase of a weight and inertia and increase of a drive thrust were brought about. furthermore, the sensitization substrate 252 -- future -- **** -- a bird clapper is expected greatly and it is expected that enlargement also of a movable stage is enhanced Moreover, since it was the composition that a stage activation point (position of the driving shaft of the Y linear motor 232,234) and a stage coordinate reading position (incidence position of the laser beam for distance measurement from the laser interferometer 246 to the long mirror 250) changed relatively with stage movement, conventionally, the dynamics of a mechanical system changed with the stage position, and the problem of being hard to control also had it. Therefore, in order to obtain positioning accuracy, the positioning time, and a uniform performance, the rigidity of a mechanical system and the attenuation

performance needed to be made to raise, and the expensive quality of the material had to be used, or it had to be made the complicated configuration, and the cost rise was caused.

[0010] this invention aims at offering the movable stage equipment which can realize a long stroke in view of the trouble of such conventional technology, without making a moving-part weight increase. Moreover, even if a stage moves, a stage activation point and a stage coordinate reading position do not change relatively, but this invention aims at offering the stage equipment with which high controllability ability and high positioning accuracy are obtained. Furthermore, this invention aims at offering the highly efficient aligner incorporating such stage equipment.

[0011]

[Means for Solving the Problem] While fixing to the portion which does not carry out movable [of the long mirror] in this invention and realizing lightweight-ization of the moving part of stage equipment for solution of the above-mentioned trouble, it considered as the mechanical component (actuator) which drives a stage, and the composition which does not change the relative position of reading of a laser interferometer by stage movement. Since according to the stage equipment of this invention the actuator for stage position control and the laser interferometer reading position for stage position measurement do not call at the position of a stage but become always fixed, the design of a control controller becomes easy and it is advantageous to the improvement in positioning accuracy.

[0012] Namely, the movable stage where the stage equipment by this invention can move in the 1st direction (the direction of Y), and the 2nd direction (the direction of X) (PST), In stage equipment (13 15) equipped with the position detection equipment which detects the position of the aforementioned movable stage (PST) to the long mirror (75 77) formed in the base member (19) The optical equipment (interferometer unit) (81, 82, 83; 121,122,123) in which the detection light (L1, L2, L3) which detects the position of the movable stage (PST) to a long mirror (75 77) was prepared on the movable stage is minded. The light transmission optical system which carries out light transmission to a long mirror (75 77) (91, 92, 93; 131,132,133), It is characterized by having move equipment (72,102) made to move the aforementioned light transmission optical system (91, 92, 93; 131,132,133) in the 1st direction (the direction of Y) of the above according to movement of the 1st direction of a movable stage (PST, RST).

[0013] The base member (19) is supported possible [movement of a movable stage (PST)]. Move equipment (72,102) shall move a movable stage (PST) in the 1st direction (the direction of Y) of the above. Moreover, it has stage move equipment made to move in the 2nd direction (the direction of X) on a movable stage (PST). the move shaft to which the stage move equipment made to move in the 2nd direction (the direction of X) on a movable stage (PST) moves a movable stage (PST), and the optical equipment (interferometer unit) (81, 82, 83; 121,122,123) with which it was prepared in the movable stage (PST) and the optical axis between long mirrors (75 77) -- about -- it is desirable that I am doing one

[0014] Position detection equipment is equipped with the detector (interferometer receiver 78) arranged at the vibration separation member (79) separated in [a base member (19)] vibration. The aligner by this invention is characterized by using the above-mentioned stage equipment as one [at least] stage of a mask stage (RST) and a substrate stage (PST) in the aligner (11) which exposes the pattern of the mass (R) held at the mask stage (RST) to the substrate (P) held on the substrate stage (PST). This aligner (11) shall be equipped with the projection optical system (PL) which projects the pattern of a mask (R) on a substrate (P). It can hold by the member with common projection optical system (PL) and long mirror (75 77). Moreover, you may constitute a long mirror in the member united with the projection optical system.

[0015]

[Embodiments of the Invention] Hereafter, the gestalt of operation of this invention is explained with reference to a drawing. Here, the stage equipment of this invention is explained using the example in the case of applying the pattern of the reticle as a mask to the aligner of step - exposed to the glass substrate of a square shape, and - scanning method. In this aligner, it shall apply to both substrate stages where hold the mask stage and glass substrate which hold a mask and move the stage equipment of this invention, and it moves.

[0016] Drawing 1 is the schematic diagram showing an example of the aligner 11 by this invention. This aligner 11 is equipped with the substrate stage equipment (stage equipment) 15 grade which holds the main part column 14 and glass-substrate P holding the lighting optical system 12, the mask-stage equipment (stage equipment) 13 which holds Mask R and moves, a projection optical system PL, and a projection optical system PL, and moves. In addition, with the gestalt of this operation, a liquid crystal display element pattern shall be exposed to large-sized 800x950mm glass-substrate P as an example.

[0017] The lighting optical system 12 consists of a light source unit, a shutter, secondary light source formation optical system, a beam splitter, a condenser lens system, a mask blind, and an image formation lens system (all are un-illustrating), and illuminates the lighting field of the rectangle on the mask R held at mask-stage equipment 13 (or circular) with a uniform illuminance by the lighting light IL as indicated by JP,9-320956,A.

[0018] The main part column 14 consists of the 1st column 17 held on the upper surface of the base plate BP used as the criteria of the equipment laid in the upper surface of the installation floor FD through the vibrationproofing base 16 of plurality (here, two by the side of a front face are illustrated in four, however drawing 1), and the 2nd column 18 formed on this 1st column 17. The passive type thing for which this vibrationproofing base 16 used elastic material, such as rubber, as a damping material is arranged.

[0019] The 1st column 17 was supported almost horizontally by four vibrationproofing bases 16, and it is equipped with the **** surface plate 21 which constitutes the top-plate section of the 1st column 17 while it connects mutually the upper-limit section of the base 19 of the rectangle which constitutes substrate stage equipment 15, the four legs 20 arranged in the portion of four corners of the upper surface of this base 19 along the perpendicular direction, respectively, and these four legs 20. The base 19 consists of stone surface plates. There is nothing. If thermal spraying of the ceramic is carried out to this stone surface plate and it carries out a coat to it, degradation of the profile irregularity by the chip of a stone surface plate can be prevented. Opening 21A of a plane view round shape is formed in the center section of this **** surface plate 21, and the projection optical system PL is inserted from the upper part into this opening 21A. this projection optical system PL -- Chuo of the height direction -- Flange floor line is formed a little in the downward position, and the projection optical system PL is supported from the lower part by the **** surface plate 21 through Flange floor line

[0020] The 2nd column 18 is equipped with the top-plate section 23 which connects between [of the four legs 22 set up so that a projection optical system PL might be surrounded on the upper surface of the **** surface plate 21, and these four legs 22] the upper-limit sections, i.e., the base which constitutes mask-stage equipment 13. Opening 23A used as the path of the lighting light IL is formed in the center section of the base 23. In addition, you may form the whole base 23 or a part (portion equivalent to opening 23A) by light-transmission nature material. Thus, the vibration from the installation floor FD to the constituted main part column 14 is insulated by the vibrationproofing base 16 on micro G level.

[0021] as a projection optical system PL, the direction of the optical axis AX considers as Z

shaft orientations -- having -- here -- a both-sides tele cent -- the dioptric system which consists of two or more lens element arranged at intervals of predetermined along the optical-axis AX direction so that it may become rucksack optical arrangement is used This projection optical system PL has the predetermined projection scale factor, for example, actual size. For this reason, if the lighting field of Mask R is illuminated by the lighting light IL from the lighting optical system 12, the actual size erect image of the pattern of the lighting field portion on Mask R will be exposed through a projection optical system PL by the lighting light which passed Mask R to an exposure field [conjugate / field / lighting / aforementioned / on glass-substrate P by which the photoresist was applied to the front face] /.

[0022] Drawing 2 is the appearance perspective diagram of substrate stage equipment 15. The substrate stage PST where surfacing support of this substrate stage equipment 15 was carried out by non-contact above the base 19 and the base 19 (stage main part) The X linear motor 64 as a linear motor which drives the substrate stage PST to X shaft orientations which are scanning directions, The Y linear motors 65A and 65B as a linear motor which drives the substrate stage PST to Y shaft orientations which are the step move directions, It consists of frames 54 and 55 for reaction force interception which receive the reaction force produced with the drive of the substrate stage PST by the Y linear motors 65A and 65B. The frames 54 and 55 for reaction force interception are installed independently in vibration to the base 19, when supported by the supporter material 62 by which the end was fixed to the floor line FD. Since the reaction force generated by these frames 54 and 55 for reaction force interception when the substrate stage PST drives in the direction of Y is transmitted to a floor, this reaction force does not get across to a projection optical system PL.

[0023] The X linear motor 64 consists of X carriage 67 as the stators 66A and 66B installed in accordance with X shaft orientations, and a needle which the substrate stage PST is fixed and is displaced relatively to a stator 66. Stators 66A and 66B are formed in the upper part of the X guide 68 installed in accordance with X shaft orientations. And on both sides of the X guide 68, the movable member 69 is the X carriage 67 and really formed in the X carriage 67 free [movement] to the X guide 68-like. Moreover, the air pad 70 (pneumatic bearing) made from a ceramic is arranged in a base side, and surfacing support of the movable member 69 is carried out to the base 19. Glass-substrate P is held by vacuum adsorption etc. through a non-illustrated substrate electrode holder on the upper surface of the substrate stage PST.

[0024] Y linear motor 65A consists of needle 57A prepared in -X side edge section of the Y guide 68, and stator 59A supported on the frame 54 for reaction force interception. Moreover, it consists of needle 57B prepared in +X side edge section of the Y carriage 72 which can move freely along with the Y guide 71 in which Y linear motor 65B was installed in accordance with Y shaft orientations, and stator 59B supported on the frame 55 for reaction force interception. Each stators 59A and 59B are presenting the shape of a KO character which carries out opening towards the substrate stage PST so that Needles 57A and 57B may be put. In addition, the X guide 68 is being fixed to -X side edge section of the Y carriage 72.

[0025] Coordinate position measurement of X of the substrate stage PST and the direction of Y is performed using a laser interferometer. For coordinate position measurement of the direction of X of the substrate stage PST, the long boundary 75 for laser interferometers is fixed through the supporter material 74 on the base 19, and the interferometer units 81 and 82 which made the cube corner reflector and the plane mirror the pair on the substrate stage PST are arranged. Moreover, the long boundary 77 for laser interferometers is fixed through the supporter material 76 on the base 19 for coordinate position measurement of

the direction of Y of the substrate stage PST, and the interferometer 83 which made the cube corner reflector and the plane mirror the pair on the substrate stage PST is arranged. The interferometer receiver 78 which held the laser light source and electric eye the laser interferometer units 81 and 82 and for 83 is installed independently in vibration to the base 19 by supporting to the supporter material 79 by which the end was fixed to the floor line FD. Since the interferometer receiver 78 can install in the place separated from equipment as usual since it was not necessary to carry out movable, the exoergic influence of a receiver does not have him and he does not need to take about wiring. Moreover, the reflecting mirrors 91, 92, and 93 for optical-path bending which constitute an interferometer path are installed on the Y carriage 72.

[0026] Drawing 3 is an outline plan for explaining the composition of the laser interferometer by this invention. On the substrate stage PST, two interferometer units 81 and 82 for coordinate position measurement of the direction of X of the substrate stage PST and one interferometer unit 83 for coordinate position measurement of the direction of Y of the substrate stage PST are installed. Moreover, it is arranged on the Y carriage 72 which the reflecting mirrors 91-93 which constitute an interferometer path move in the direction of Y along with the Y guide 71. The laser beam L1 for measurement by which outgoing radiation was carried out from the laser light source in the interferometer receiver 78 It is reflected with the reflecting mirror 91 on the Y carriage 72, and incidence is carried out to the interferometer unit 81. The interference light in which the laser beam reflected in the criteria mirror of an interferometer unit and the laser beam reflected on the long boundary 75 fixed to the base 19 carried out optical interference and which it generated in the interferometer unit 81 After carrying out outgoing radiation from the interferometer unit 81, it goes on to the incidence laser beam L1 and an opposite direction, and it is reflected with the reflecting mirror 91 on the Y carriage 72, and returns to the interferometer receiver 78. [0027] Similarly the laser beam L2 by which outgoing radiation was carried out from the laser light source in the interferometer receiver 78 It is reflected with the reflecting mirror 92 on the Y carriage 72, and incidence is carried out to the interferometer unit 82. The laser beam reflected in the criteria mirror of an interferometer unit and the laser beam reflected on the long boundary 75 fixed to the base 19 carry out optical interference in the interferometer unit 82. After carrying out outgoing radiation from the interferometer unit 81, it goes on to the incidence laser beam L2 and an opposite direction, and it is reflected with the reflecting mirror 92 on the Y carriage 72, and an interference light returns to the interferometer receiver 78. Moreover, the laser beam L3 by which outgoing radiation was carried out from the laser light source in the interferometer receiver 78 It is reflected with the reflecting mirror 93 on the Y carriage 72, and incidence is carried out to the interferometer unit 83. The interference light generated by interference with the laser beam reflected in the criteria mirror of the interferometer unit 83, and the laser beam reflected on the long boundary 77 fixed to the base 19 It goes on to the incidence laser beam L3 and an opposite direction, it is reflected with the reflecting mirror 93 on the Y carriage 72, and returns to the interferometer receiver 78.

[0028] Thus, by carrying out incidence of the laser beam to the interferometer units 81, 82, and 83 from the reflecting mirrors 91, 92, and 93 arranged on the Y carriage 72 which moves in the direction of Y with the substrate stage PST along with the Y guide 71, even if the substrate stage PST moves in the direction of Y, incidence of the laser beam can be correctly carried out to the interferometer units 81, 82, and 83 on the substrate stage PST. Moreover, the interference light which carried out outgoing radiation of the interferometer units 81, 82, and 83 goes back an incident-light way, and returns to the interferometer receiver 78. The parts which carry out interference measurement with a laser interferometer are an interval between the interferometer units 81 and 82 on the substrate stage PST, and

the long mirror 75, and the distance between the interferometer unit 83 and the long mirror 77. Therefore, although some optical system which constitutes an interferometer path is carried on the Y carriage 72, even if the Masanao nature of the portion is bad, a measurement error does not occur.

[0029] The long boundary 75 has the length which covers the move stroke of the direction of Y of the interferometer units 81 and 82 which move with the substrate stage PST, and the long boundary 77 has the length which covers the move stroke of the direction of X of the interferometer unit 83 which rides and moves to the substrate stage PST similarly. Moreover, the optical path of the laser beam which goes back and forth between the interferometer unit 81 and the long mirrors 75 is set up on stator 66A installed in accordance with X shaft orientations of the X linear motor 64. That is, the interferometer unit 81 measures the distance between the substrate stage PST and the long mirror 75 in the position where the driving force of the X linear motor 64 acts. Similarly the optical path of the laser beam which goes back and forth between the interferometer unit 82 and the long mirrors 75 is set up on stator 66B installed in accordance with X shaft orientations of the X linear motor 64, and the interferometer unit 81 measures the distance between the substrate stage PST and the long mirror 75 in the position where the driving force of the X linear motor 64 acts.

[0030] Drawing 4 is a schematic diagram explaining the structure of an interferometer unit. Although here explains taking the case of the interferometer unit 81, other interferometer units 82 and 83 have the same structure. The interferometer unit 81 consists of a polarization beam splitter 95, a criteria mirror 96, a cube corner reflector 97, and quadrant wavelength plates 98 and 99.

[0031] Incidence of the laser beam L1 reflected with the reflecting mirror 91 on the Y carriage 72 is carried out to the polarization beam splitter 95 of the interferometer unit 81, and it is divided into the transmitted light component 1 and the reflected light component 2 by the polarization beam splitter 95. It is reflected in the criteria mirror 96 through the quadrant wavelength plate 98, and the 90 degrees of the polarization directions rotate through the quadrant wavelength plate 98 again, it is shortly reflected by the polarization beam splitter 95, and incidence of the reflected light component 1 is carried out to a cube corner reflector 97. It is again reflected by the polarization beam splitter 95, and the laser beam which has returned from the cube corner reflector 97 progresses, and carries out incidence of the optical path 3 to the criteria mirror 96. The laser beam reflected in the criteria mirror penetrates a polarization beam splitter 95 as it is, and it carries out outgoing radiation from the interferometer unit 81.

[0032] On the other hand, it is reflected in the long mirror 75 through the quadrant wavelength plate 99, and through the quadrant wavelength plate 99, the 90 degrees of the polarization directions rotate, they penetrate a polarization beam splitter 95, and carry out incidence of the reflected light component 2 to a cube corner reflector 97 again. The light which has returned from the cube corner reflector 97 penetrates a polarization beam splitter 95 again, progresses and carries out incidence of the optical path 4 to the long mirror 75. It is reflected by the polarization beam splitter 95, and outgoing radiation of the laser beam reflected in the long mirror is carried out from the interferometer unit 81.

[0033] In this way, after outgoing radiation of the interference light with the laser beam which went back and forth between the laser beams and the long mirrors 75 which went back and forth between the criteria mirrors 96 two times two times is carried out from the interferometer unit 81 and it is reflected with the reflecting mirror 91 on the Y carriage 72, incidence is carried out to the interferometer receiver 78, and it is detected. The distance between a polarization beam splitter 95 and the criteria mirror 96 is eternal. On the other hand, the distance between a polarization beam splitter 95 and the long mirror 75 changes

with movements of the substrate stage PST, the interference state of the interference light which carries out outgoing radiation becomes a thing reflecting the distance of the interferometer unit 81 and the long mirror 75 from the interferometer unit 81, and the interferometer receiver 78 measures the distance of the interferometer unit 81 and the long mirror 75 from change of an interference fringe. In the example of illustration, the direction coordinate of X of the substrate stage PST is searched for by taking the average of the distance measurement value by the interferometer unit 81, and the distance measurement value by the interferometer unit 82, the division of the difference of the distance measurement value by the interferometer unit 81 and the interferometer unit 82 is carried out in the direction distance of Y of both the interferometers units 81 and 82, and the angle of rotation of the substrate stage PST is measured. Moreover, the direction coordinate of Y of the substrate stage PST is calculated from the distance measurement value using the interferometer unit 83.

[0034] The mask stage RST which returns to drawing 1 and by which surfacing support of the mask-stage equipment 13 was carried out by non-contact above the aforementioned base 23 and the base 23 (stage main part), While driving a mask stage RST by predetermined stroke to Y shaft orientations which are scanning directions (the relative-displacement direction) X shaft orientations which intersect perpendicularly with Y shaft orientations are equipped with the mask drive system 24 which carries out a minute drive, and the frames 25 and 26 for reaction force interception (supporter) which receive the reaction force produced with the drive of the mask stage RST by this mask drive system. It is being fixed to the **** surface plate 21 shown in drawing 1, the base 19, and the base plate BP by the floor line FD through opening formed, respectively, and the end face of the frames 25 and 26 for reaction force interception misses to the floor the reaction force generated by movement of a mask stage RST. The above-mentioned reaction force is not transmitted to a projection optical system PL by these frames 25 and 26 for reaction force interception. For this reason, high exposure of precision is realizable.

[0035] The drive system of mask-stage equipment 13 has the same structure as the drive system of the substrate stage PST, and has the composition as the coordinate position detection equipment of the substrate stage PST also with the same coordinate position detection equipment of a mask stage RST using the laser interferometer. In addition, although considered as the composition which presents the shape of a KO character in which a stator carries out opening towards a stage with the gestalt of the above-mentioned operation, as shown, for example in drawing 5, you may be the composition in which Stators 59A and 59B carry out opening towards + Z direction. In this case, what is necessary is just to make a needle into the configuration which hangs to - Z direction [into a stator]. Moreover, the Y linear motor 64 and the X linear motors 65A and 65B which are the above-mentioned linear motors can apply both of the moving-coil-type and MUBINGU magnet type form.

[0036] Moreover, this invention is applicable also to the stage equipment driven with driving gears other than a linear motor. Drawing 6 is the outline perspective diagram showing the example which applied this invention to the substrate stage equipment driven with a ball screw, and drawing 7 is the outline plan.

[0037] This substrate stage equipment is equipped with the mechanism for driving the substrate stage PST and the substrate stage PST in which it is located above the base 19 and the base 19. A drive is equipped with the X motor 113 which carries out the rotation drive of the ball screw 114 and it, and the Y motor 103 which carries out the rotation drive of the ball screw 104 and it. Glass-substrate P is held by vacuum adsorption etc. through a non-illustrated substrate electrode holder on the upper surface of the substrate stage PST. The Y motor 103 drives the Y carriage 102 along with the Y guide 101. The X guide 111 is being

fixed to -X side edge section of the Y carriage 102. It moves in the direction of Y with the Y carriage 102 by driving the Y motor 103 on the substrate stage PST, and moves in the direction of X along with the X guide 111 from driving the X motor 113.

[0038] Coordinate position measurement of X of the substrate stage PST and the direction of Y is performed using a laser interferometer like said stage equipment. For coordinate position measurement of the direction of X of the substrate stage PST, the long boundary 75 for laser interferometers is fixed through the supporter material 74 on the base 19, and the interferometer unit 121, 122 which made the cube corner reflector and the plane mirror the pair on the substrate stage PST is arranged. Moreover, the long boundary 77 for laser interferometers is fixed through the supporter material 76 on the base 19 for coordinate position measurement of the direction of Y of the substrate stage PST, and the interferometer 123 which made the cube corner reflector and the plane mirror the pair on the substrate stage PST is arranged. Moreover, the reflecting mirror 131, 132, 133 for optical-path bending which constitutes an interferometer path is installed on the Y carriage 102.

[0039] The optical path of the laser beam which goes back and forth between the interferometer unit 122 and the long mirrors 75 is set up on the position 114 where the driving force by the X motor 113 acts on the substrate stage PST, i.e., a ball screw. In this way, the interferometer unit 122 measures the distance between the substrate stage PST and the long mirror 75 in the position where the driving force of the X motor 113 acts. By the distance measurement value by the interferometer unit 122, the direction coordinate of X of the substrate stage PST is searched for, the division of the difference of the distance measurement value by the interferometer unit 121 and the interferometer unit 122 is carried out in the direction distance of Y of both the interferometers unit 121, 122, and the angle of rotation of the substrate stage PST is measured. Moreover, the direction coordinate of Y of the substrate stage PST is calculated from the distance measurement value using the interferometer unit 123.

[0040] Since the relative position of the actuator for a drive and the laser interferometer which measures a moving-part position does not change according to this invention, even if stage moving part is in which position of X and a Y coordinate system, the frequency response of a control system does not change. Therefore, it becomes filterable by the control controller and still higher controllability ability is obtained.

[0041] Moreover, in order to require flatness high to the field of a member in which a long mirror is attached in order to maintain the precision of a long mirror plane until now and to maintain it, rigidity could not but be needed, and it surely could not but become thick heavy parts. However, it can constitute from this invention, without taking into consideration to the weight of not only the weight of the main part of a long mirror but the member to support, since it is possible to have a long mirror in a fixed side. Therefore, the long mirror could be incorporated, without completely spoiling flatness.

[0042] We are anxious about the interferometer composition by this invention producing an Abbe error. Since the laser beam side which performs position measurement will move when based on the projection optical system PL which does not move during exposure especially, the error proportional to the interval (Δx or Δy) of a laser beam and a projection optical system PL will arise. However, even if it is that case, an Abbe error can be made to cancel by applying amendment, using the error of the direction of Y as $\Delta x - \Delta \theta$ using the error of the direction of X as $\Delta y - \Delta \theta$, since it is acting as the monitor of all the variation rates of the direction of X of moving part (the substrate stage PST, mask stage RST), the direction of Y, and the direction of θ .

[0043] Although considered as the composition which applies the stage equipment of this invention to an aligner 11 with the gestalt of the above-mentioned implementation, it is not

limited to this and can apply also to precise measurement devices, such as drawing equipment of an imprint mask, and a position-coordinate measuring device of a mask pattern, besides aligner 11. As a substrate, the original edition (synthetic quartz, silicon wafer) of not only glass-substrate [for liquid crystal display devices] P but the semiconductor wafer for semiconductor devices, the ceramic wafer for the thin film magnetic heads, the mask used by the aligner, or a mask etc. is applied.

[0044] The pattern of Mask R can be exposed in the state where Mask R and glass-substrate P other than the scanned type aligner (scanning stepper; U.S. Pat. No. 5,473,410) of step - which carries out the synchronized drive of RETEKURU R and the glass-substrate P, and carries out scanning exposure of the pattern of Mask R as an aligner 11, and - scanning method were stood still, and it can apply also to the projection aligner (stepper) of a step-and-repeat method which carries out step movement of the glass-substrate P one by one. As a kind of aligner 11, it is not restricted to the aligner for liquid crystal display device manufacture, but can apply to the aligner for manufacturing an aligner, the thin film magnetic head, an image pick-up element (CCD) or a mask for the semiconductor-device manufacture which exposes a semiconductor-device pattern to a wafer, etc. widely.

[0045] Moreover, charged-particle lines, such as the bright line (g line (436nm), h line (404.7nm), i line (365nm)) and the KrF excimer laser (248nm) which are generated from an extra-high pressure mercury lamp, an ArF excimer laser (193nm), and not only F2 laser (157nm) but an X-ray, and an electron ray, can be used as the light source of the lighting light for exposure. For example, when using an electron ray, a thermocouple-emission type lanthanum HEKISABO light (LaB6) and a tantalum (Ta) can be used as an electron gun. Furthermore, when using an electron ray, it is good also as composition which uses Mask R, and is good also as composition which forms a pattern on a direct wafer, without using Mask R. Moreover, you may use higher harmonics, such as a YAG laser and semiconductor laser, etc.

[0046] Any of not only unit systems but a reduction system and an expansion system are sufficient as the scale factor of a projection optical system PL. Moreover, what is necessary is just to use the electron optics system which consists of an electron lens and deflecting system as optical system, in making it the optical system of a reflective refraction system or a refraction system using the material which penetrates far ultraviolet rays, such as a quartz and fluorite, as ** material as a projection optical system PL when using far ultraviolet rays, such as an excimer laser, when using F2 laser and an X-ray (Mask R uses a reflected type thing), and using an electron ray. In addition, the optical path which an electron ray passes cannot be overemphasized by making it a vacua. Moreover, it can apply also to the BUROKISHIMI tee aligner which Mask R and Wafer W are made close and exposes the pattern of Mask R, without using a projection optical system PL.

[0047] You may use the flat-surface motor which the magnet unit (permanent magnet) which has arranged the magnet to two dimensions, and the armature unit which has arranged the coil to two dimensions are made to counter as a drive of each stages RST and PST, and drives each stages RST and PST with electromagnetic force. In this case, what is necessary is to connect either of a magnet unit and an armature unit to Stages RST and PST, and just to establish another side of a magnet unit and an armature unit in the move both sides (base) of Stages RST and PST.

[0048]

[Effect of the Invention] Since it is not necessary to constitute the long mirror which requires precision in moving part as mentioned above according to this invention, not only long Shigekazu Kagami but the member which concludes it with a sufficient precision can be omitted, and a moving-part weight can be mitigated sharply. Therefore, the resonance

frequency of a mechanical system can increase, the high frequency response of a control system can be taken, and controllability ability can be raised.

TECHNICAL FIELD

[The technical field to which invention belongs] this invention relates to the stage equipment built into the aligner which exposes a pattern to a substrate by the manufacturing process of a semiconductor device or a liquid crystal display panel, and its aligner.

PRIOR ART

[Description of the Prior Art] Step [of the former / drawing 8] - and the schematic diagram of the scanned type aligner of - scanning method, and drawing 9 are the perspective diagrams showing the outline composition of the substrate stage (X-Y stage). The lighting light IL for the exposure from the light source 201 illuminates a mask 207 by the uniform illumination distribution. Projection exposure of the image through the projection optical system 211 of the pattern on a mask 207 is carried out at the substrate 252 to which the photoresist was applied. A mask 207 is held on a mask stage RST, and a mask stage RST drives it by the linear motor in the direction of Y which is the direction of a scan on the mask base RSB. The Y coordinate of a mask 207 is measured by Y move mirror 208 and the external laser interferometer 209, and the main-control system 210 to which this Y coordinate carries out control of the operation of the whole equipment is supplied. The main-control system 210 performs the position of a mask 207, and control of traverse speed through the mask-stage drive system 219.

[0003] Moreover, by the move mirror 250 for the Y-axes fixed to the upper limit of the top-plate section 238 of the linear motor drive X-Y stage mentioned later, and the external laser interferometer 246, the monitor of the Y coordinate of the sensitization substrate 252 is always carried out, and the detected Y coordinate is supplied to the main-control system 210. The main-control system 210 controls operation of the X linear motor 224,226 and the Y linear motor 232,234 through a drive system 223 based on the supplied coordinate.

[0004] Next, the sensitization substrate 252 is explained using drawing 9 about the substrate stage (X-Y stage) where it lays and moves. X-Y stage 200 is equipped with the 1st mobile 216 which can move in the direction of X, and the 2nd mobile 236 which can move in the direction of Y which intersects perpendicularly in the direction of X along with the Y guide 222 as a move guide which constitutes this 1st mobile 216 along with the X guide 214, and the surface plate 212 upper surface and the X guide 214 as a guide bar fixed on the surface plate 212 and the surface plate 212. The X guide 214 is arranged along the direction of X near the end side of the direction of Y on a surface plate 212. The 1st mobile 216 has 1st Y guide conveyance object 218 which approached the X guide 214 on the surface plate 212, and has been arranged along the direction of X, it and 2nd Y guide conveyance object 220 arranged on a surface plate 212 at parallel, and the Y guide 222 prolonged in the direction of Y constructed among them.

[0005] Stator 224A of the 1st X linear motor 224 approaches the X guide 214, and is installed in the direction of X by the unilateral of the direction of Y of the X guide 214 on a surface plate 212. Moreover, stator 226A of the 2nd X linear motor 226 is installed in the direction of X near the other end of the direction of Y on a surface plate 212 at the side besides the direction of Y of 2nd Y guide conveyance object 220. needle 224B of the 1st X linear motor 224 -- connection -- it connects with the end of the Y guide 222 through a member 228 -- having -- **** -- needle 226B of the 2nd X linear motor 226 -- connection - - it connects with the other end of the Y guide 22 through the member 230 For this reason,

the 1st mobile 216 drives in the direction of X by movement of the needles 224B and 226B of the 1st and 2nd X linear motor 224,226.

[0006] The stators 232A and 234A of the 1st and 2nd Y linear motor 232,234 are arranged along the direction of Y, and suspension is carried out to the unilateral of the direction of X of the Y guide 222, and the side else between the 1st and 2nd Y guide conveyance object 218,220. The linear motor of the MUBINGU magnet type also as the 1st and 2nd Y linear motor is used.

[0007] The 2nd mobile 236 has Y directional-axis acceptor 242,242 of the couple which connects mutually the top plates 238 and bottom plates 240 which have been mostly arranged in parallel with mutual on the upper surface (datum level) of a surface plate 212 at parallel in the state of pinching the Y guide 222 from the upper and lower sides, and these top plates 238 and bottom plates 240 on both sides of the Y guide 22. These Y directional-axis acceptors 242,242 are arranged in parallel with the Y guide 222, where a predetermined gap is formed between the Y guides 222. The needles 232B and 234B (however, 234B is not shown) of the 1st and 2nd Y linear motor 232,234 which constitute the driving means of the 2nd mobile 236 and which were mentioned above are attached in the external surface of these Y directional-axis acceptors 242,242, and the 2nd mobile 236 drives in the direction of Y by movement of the needles 232B and 234B of the Y linear motor 232,234.

[0008] The top-plate section 238 serves as the **** stage, and long X move mirror 248 which reflects the laser beam emitted from the laser interferometer 244 for X coordinate measurement and the laser interferometer 246 for Y coordinate measurement which were fixed on the surface plate 212, long Y move mirror 250, and the sensitization substrate 252 are carried in the upper surface of this top-plate section 238. If the 1st, the 2nd X linear motor 224,226, the 1st, and 2nd Y linear motor 232,234 drives, the 2nd mobile 236 in which the sensitization substrate 252 was carried according to this will move in X and the Y two-dimensional direction, and the move position will be measured by the laser interferometer 244,246.

EFFECT OF THE INVENTION

[Effect of the Invention] Since it is not necessary to constitute the long mirror which requires precision in moving part as mentioned above according to this invention, not only long Shigekazu Kagami but the member which concludes it with a sufficient precision can be omitted, and a moving-part weight can be mitigated sharply. Therefore, the resonance frequency of a mechanical system can increase, the high frequency response of a control system can be taken, and controllability ability can be raised.

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] However, in said conventional aligner, the composition which lays a long mirror in the moving part (movable stage) of stage equipment needed to be taken, when the stroke of a movable stage was lengthened, a long longer mirror will be put on moving part, and degradation of the controllability accompanying increase of a weight and inertia and increase of a drive thrust were brought about. furthermore, the sensitization substrate 252 -- future -- **** -- a bird clapper is expected greatly and it is expected that enlargement also of a movable stage is enhanced Moreover, since it was the composition that a stage activation point (position of the driving shaft of the Y linear motor 232,234) and a stage coordinate reading position (incidence position of the laser beam for distance measurement from the laser interferometer 246 to

the long mirror 250) changed relatively with stage movement, conventionally, the dynamics of a mechanical system changed with the stage position, and the problem of being hard to control also had it. Therefore, in order to obtain positioning accuracy, the positioning time, and a uniform performance, the rigidity of a mechanical system and the attenuation performance needed to be made to raise, and the expensive quality of the material had to be used, or it had to be made the complicated configuration, and the cost rise was caused. [0010] this invention aims at offering the movable stage equipment which can realize a long stroke in view of the trouble of such conventional technology, without making a moving-part weight increase. Moreover, even if a stage moves, a stage activation point and a stage coordinate reading position do not change relatively, but this invention aims at offering the stage equipment with which high controllability ability and high positioning accuracy are obtained. Furthermore, this invention aims at offering the highly efficient aligner incorporating such stage equipment.

MEANS

[Means for Solving the Problem] While fixing to the portion which does not carry out movable [of the long mirror] in this invention and realizing lightweight-ization of the moving part of stage equipment for solution of the above-mentioned trouble, it considered as the mechanical component (actuator) which drives a stage, and the composition which does not change the relative position of reading of a laser interferometer by stage movement. Since according to the stage equipment of this invention the actuator for stage position control and the laser interferometer reading position for stage position measurement do not call at the position of a stage but become always fixed, the design of a control controller becomes easy and it is advantageous to the improvement in positioning accuracy.

[0012] Namely, the movable stage where the stage equipment by this invention can move in the 1st direction (the direction of Y), and the 2nd direction (the direction of X) (PST), In stage equipment (13 15) equipped with the position detection equipment which detects the position of the aforementioned movable stage (PST) to the long mirror (75 77) formed in the base member (19) The optical equipment (interferometer unit) (81, 82, 83; 121,122,123) in which the detection light (L1, L2, L3) which detects the position of the movable stage (PST) to a long mirror (75 77) was prepared on the movable stage is minded. The light transmission optical system which carries out light transmission to a long mirror (75 77) (91, 92, 93; 131,132,133), It is characterized by having move equipment (72,102) made to move the aforementioned light transmission optical system (91, 92, 93; 131,132,133) in the 1st direction (the direction of Y) of the above according to movement of the 1st direction of a movable stage (PST, RST).

[0013] The base member (19) is supported possible [movement of a movable stage (PST)]. Move equipment (72,102) shall move a movable stage (PST) in the 1st direction (the direction of Y) of the above. Moreover, it has stage move equipment made to move in the 2nd direction (the direction of X) on a movable stage (PST). the move shaft to which the stage move equipment made to move in the 2nd direction (the direction of X) on a movable stage (PST) moves a movable stage (PST), and the optical equipment (interferometer unit) (81, 82, 83; 121,122,123) with which it was prepared in the movable stage (PST) and the optical axis between long mirrors (75 77) -- about -- it is desirable that I am doing one

[0014] Position detection equipment is equipped with the detector (interferometer receiver 78) arranged at the vibration separation member (79) separated in [a base member (19)] vibration. The aligner by this invention is characterized by using the above-mentioned stage equipment as one [at least] stage of a mask stage (RST) and a substrate stage (PST) in the

aligner (11) which exposes the pattern of the mask (R) held at the mask stage (RST) to the substrate (P) held on the substrate stage (PST). This aligner (11) shall be equipped with the projection optical system (PL) which projects the pattern of a mask (R) on a substrate (P). It can hold by the member with common projection optical system (PL) and long mirror (75 77). Moreover, you may constitute a long mirror in the member united with the projection optical system.

[0015]

[Embodiments of the Invention] Hereafter, the form of operation of this invention is explained with reference to a drawing. Here, the stage equipment of this invention is explained using the example in the case of applying the pattern of the reticle as a mask to the aligner of step - exposed to the glass substrate of a square shape, and - scanning method. In this aligner, it shall apply to both substrate stages where hold the mask stage and glass substrate which hold a mask and move the stage equipment of this invention, and it moves.

[0016] Drawing 1 is the schematic diagram showing an example of the aligner 11 by this invention. This aligner 11 is equipped with the substrate stage equipment (stage equipment) 15 grade which holds the main part column 14 and glass-substrate P holding the lighting optical system 12, the mask-stage equipment (stage equipment) 13 which holds Mask R and moves, a projection optical system PL, and a projection optical system PL, and moves. In addition, with the form of this operation, a liquid crystal display element pattern shall be exposed to large-sized 800x950mm glass-substrate P as an example.

[0017] The lighting optical system 12 consists of a light source unit, a shutter, secondary light source formation optical system, a beam splitter, a condenser lens system, a mask blind, and an image formation lens system (all are un-illustrating), and illuminates the lighting field of the rectangle on the mask R held at mask-stage equipment 13 (or circular) with a uniform illuminance by the lighting light IL as indicated by JP,9-320956,A.

[0018] The main part column 14 consists of the 1st column 17 held on the upper surface of the base plate BP used as the criteria of the equipment laid in the upper surface of the installation floor FD through the vibrationproofing base 16 of plurality (here, two by the side of a front face are illustrated in four, however drawing 1), and the 2nd column 18 formed on this 1st column 17. The passive type thing for which this vibrationproofing base 16 used elastic material, such as rubber, as a damping material is arranged.

[0019] The 1st column 17 was supported almost horizontally by four vibrationproofing bases 16, and it is equipped with the **** surface plate 21 which constitutes the top-plate section of the 1st column 17 while it connects mutually the upper-limit section of the base 19 of the rectangle which constitutes substrate stage equipment 15, the four legs 20 arranged in the portion of four corners of the upper surface of this base 19 along the perpendicular direction, respectively, and these four legs 20. The base 19 consists of stone surface plates. There is nothing. If thermal spraying of the ceramic is carried out to this stone surface plate and it carries out a coat to it, degradation of the profile irregularity by the chip of a stone surface plate can be prevented. Opening 21A of a plane view round shape is formed in the center section of this **** surface plate 21, and the projection optical system PL is inserted from the upper part into this opening 21A. this projection optical system PL -- Chuo of the height direction -- Flange floor line is formed a little in the downward position, and the projection optical system PL is supported from the lower part by the **** surface plate 21 through Flange floor line

[0020] The 2nd column 18 is equipped with the top-plate section 23 which connects between [of the four legs 22 set up so that a projection optical system PL might be surrounded on the upper surface of the **** surface plate 21, and these four legs 22] the upper-limit sections, i.e., the base which constitutes mask-stage equipment 13. Opening

23A used as the path of the lighting light IL is formed in the center section of the base 23. In addition, you may form the whole base 23 or a part (portion equivalent to opening 23A) by light-transmission nature material. Thus, the vibration from the installation floor FD to the constituted main part column 14 is insulated by the vibrationproofing base 16 on micro G level.

[0021] as a projection optical system PL, the direction of the optical axis AX considers as Z shaft orientations -- having -- here -- a both-sides tele cent -- the dioptric system which consists of two or more lens element arranged at intervals of predetermined along the optical-axis AX direction so that it may become rucksack optical arrangement is used This projection optical system PL has the predetermined projection scale factor, for example, actual size. For this reason, if the lighting field of Mask R is illuminated by the lighting light IL from the lighting optical system 12, the actual size erect image of the pattern of the lighting field portion on Mask R will be exposed through a projection optical system PL by the lighting light which passed Mask R to an exposure field [conjugate / field / lighting / aforementioned / on glass-substrate P by which the photoresist was applied to the front face] /.

[0022] Drawing 2 is the appearance perspective diagram of substrate stage equipment 15. The substrate stage PST where surfacing support of this substrate stage equipment 15 was carried out by non-contact above the base 19 and the base 19 (stage main part) The X linear motor 64 as a linear motor which drives the substrate stage PST to X shaft orientations which are scanning directions, The Y linear motors 65A and 65B as a linear motor which drives the substrate stage PST to Y shaft orientations which are the step move directions, It consists of frames 54 and 55 for reaction force interception which receive the reaction force produced with the drive of the substrate stage PST by the Y linear motors 65A and 65B. The frames 54 and 55 for reaction force interception are installed independently in vibration to the base 19, when supported by the supporter material 62 by which the end was fixed to the floor line FD. Since the reaction force generated by these frames 54 and 55 for reaction force interception when the substrate stage PST drives in the direction of Y is transmitted to a floor, this reaction force does not get across to a projection optical system PL.

[0023] The X linear motor 64 consists of X carriage 67 as the stators 66A and 66B installed in accordance with X shaft orientations, and a needle which the substrate stage PST is fixed and is displaced relatively to a stator 66. Stators 66A and 66B are formed in the upper part of the X guide 68 installed in accordance with X shaft orientations. And on both sides of the X guide 68, the movable member 69 is the X carriage 67 and really formed in the X carriage 67 free [movement] to the X guide 68-like. Moreover, the air pad 70 (pneumatic bearing) made from a ceramic is arranged in a base side, and surfacing support of the movable member 69 is carried out to the base 19. Glass-substrate P is held by vacuum adsorption etc. through a non-illustrated substrate electrode holder on the upper surface of the substrate stage PST.

[0024] Y linear motor 65A consists of needle 57A prepared in -X side edge section of the Y guide 68, and stator 59A supported on the frame 54 for reaction force interception. Moreover, it consists of needle 57B prepared in +X side edge section of the Y carriage 72 which can move freely along with the Y guide 71 in which Y linear motor 65B was installed in accordance with Y shaft orientations, and stator 59B supported on the frame 55 for reaction force interception. Each stators 59A and 59B are presenting the shape of a KO character which carries out opening towards the substrate stage PST so that Needles 57A and 57B may be put. In addition, the X guide 68 is being fixed to -X side edge section of the Y carriage 72.

[0025] Coordinate position measurement of X of the substrate stage PST and the direction

of Y is performed using a laser interferometer. For coordinate position measurement of the direction of X of the substrate stage PST, the long boundary 75 for laser interferometers is fixed through the supporter material 74 on the base 19, and the interferometer units 81 and 82 which made the cube corner reflector and the plane mirror the pair on the substrate stage PST are arranged. Moreover, the long boundary 77 for laser interferometers is fixed through the supporter material 76 on the base 19 for coordinate position measurement of the direction of Y of the substrate stage PST, and the interferometer 83 which made the cube corner reflector and the plane mirror the pair on the substrate stage PST is arranged. The interferometer receiver 78 which held the laser light source and electric eye the laser interferometer units 81 and 82 and for 83 is installed independently in vibration to the base 19 by supporting to the supporter material 79 by which the end was fixed to the floor line FD. Since the interferometer receiver 78 can install in the place separated from equipment as usual since it was not necessary to carry out movable, the exoergic influence of a receiver does not have him and he does not need to take about wiring. Moreover, the reflecting mirrors 91, 92, and 93 for optical-path bending which constitute an interferometer path are installed on the Y carriage 72.

[0026] Drawing 3 is an outline plan for explaining the composition of the laser interferometer by this invention. On the substrate stage PST, two interferometer units 81 and 82 for coordinate position measurement of the direction of X of the substrate stage PST and one interferometer unit 83 for coordinate position measurement of the direction of Y of the substrate stage PST are installed. Moreover, it is arranged on the Y carriage 72 which the reflecting mirrors 91-93 which constitute an interferometer path move in the direction of Y along with the Y guide 71. The laser beam L1 for measurement by which outgoing radiation was carried out from the laser light source in the interferometer receiver 78 It is reflected with the reflecting mirror 91 on the Y carriage 72, and incidence is carried out to the interferometer unit 81. The interference light in which the laser beam reflected in the criteria mirror of an interferometer unit and the laser beam reflected on the long boundary 75 fixed to the base 19 carried out optical interference and which it generated in the interferometer unit 81 After carrying out outgoing radiation from the interferometer unit 81, it goes on to the incidence laser beam L1 and an opposite direction, and it is reflected with the reflecting mirror 91 on the Y carriage 72, and returns to the interferometer receiver 78.

[0027] Similarly the laser beam L2 by which outgoing radiation was carried out from the laser light source in the interferometer receiver 78 It is reflected with the reflecting mirror 92 on the Y carriage 72, and incidence is carried out to the interferometer unit 82. The laser beam reflected in the criteria mirror of an interferometer unit and the laser beam reflected on the long boundary 75 fixed to the base 19 carry out optical interference in the interferometer unit 82. After carrying out outgoing radiation from the interferometer unit 81, it goes on to the incidence laser beam L2 and an opposite direction, and it is reflected with the reflecting mirror 92 on the Y carriage 72, and an interference light returns to the interferometer receiver 78. Moreover, the laser beam L3 by which outgoing radiation was carried out from the laser light source in the interferometer receiver 78 It is reflected with the reflecting mirror 93 on the Y carriage 72, and incidence is carried out to the interferometer unit 83. The interference light generated by interference with the laser beam reflected in the criteria mirror of the interferometer unit 83, and the laser beam reflected on the long boundary 77 fixed to the base 19 It goes on to the incidence laser beam L3 and an opposite direction, it is reflected with the reflecting mirror 93 on the Y carriage 72, and returns to the interferometer receiver 78.

[0028] Thus, by carrying out incidence of the laser beam to the interferometer units 81, 82, and 83 from the reflecting mirrors 91, 92, and 93 arranged on the Y carriage 72 which moves in the direction of Y with the substrate stage PST along with the Y guide 71, even if

the substrate stage PST moves in the direction of Y, incidence of the laser beam can be correctly carried out to the interferometer units 81, 82, and 83 on the substrate stage PST. Moreover, the interference light which carried out outgoing radiation of the interferometer units 81, 82, and 83 goes back an incident-light way, and returns to the interferometer receiver 78. The parts which carry out interference measurement with a laser interferometer are an interval between the interferometer units 81 and 82 on the substrate stage PST, and the long mirror 75, and the distance between the interferometer unit 83 and the long mirror 77. Therefore, although some optical system which constitutes an interferometer path is carried on the Y carriage 72, even if the Masanao nature of the portion is bad, a measurement error does not occur.

[0029] The long boundary 75 has the length which covers the move stroke of the direction of Y of the interferometer units 81 and 82 which move with the substrate stage PST, and the long boundary 77 has the length which covers the move stroke of the direction of X of the interferometer unit 83 which rides and moves to the substrate stage PST similarly. Moreover, the optical path of the laser beam which goes back and forth between the interferometer unit 81 and the long mirrors 75 is set up on stator 66A installed in accordance with X shaft orientations of the X linear motor 64. That is, the interferometer unit 81 measures the distance between the substrate stage PST and the long mirror 75 in the position where the driving force of the X linear motor 64 acts. Similarly the optical path of the laser beam which goes back and forth between the interferometer unit 82 and the long mirrors 75 is set up on stator 66B installed in accordance with X shaft orientations of the X linear motor 64, and the interferometer unit 81 measures the distance between the substrate stage PST and the long mirror 75 in the position where the driving force of the X linear motor 64 acts.

[0030] Drawing 4 is a schematic diagram explaining the structure of an interferometer unit. Although here explains taking the case of the interferometer unit 81, other interferometer units 82 and 83 have the same structure. The interferometer unit 81 consists of a polarization beam splitter 95, a criteria mirror 96, a cube corner reflector 97, and quadrant wavelength plates 98 and 99.

[0031] Incidence of the laser beam L1 reflected with the reflecting mirror 91 on the Y carriage 72 is carried out to the polarization beam splitter 95 of the interferometer unit 81, and it is divided into the transmitted light component 1 and the reflected light component 2 by the polarization beam splitter 95. It is reflected in the criteria mirror 96 through the quadrant wavelength plate 98, and the 90 degrees of the polarization directions rotate through the quadrant wavelength plate 98 again, it is shortly reflected by the polarization beam splitter 95, and incidence of the reflected light component 1 is carried out to a cube corner reflector 97. It is again reflected by the polarization beam splitter 95, and the laser beam which has returned from the cube corner reflector 97 progresses, and carries out incidence of the optical path 3 to the criteria mirror 96. The laser beam reflected in the criteria mirror penetrates a polarization beam splitter 95 as it is, and it carries out outgoing radiation from the interferometer unit 81.

[0032] On the other hand, it is reflected in the long mirror 75 through the quadrant wavelength plate 99, and through the quadrant wavelength plate 99, the 90 degrees of the polarization directions rotate, they penetrate a polarization beam splitter 95, and carry out incidence of the reflected light component 2 to a cube corner reflector 97 again. The light which has returned from the cube corner reflector 97 penetrates a polarization beam splitter 95 again, progresses and carries out incidence of the optical path 4 to the long mirror 75. It is reflected by the polarization beam splitter 95, and outgoing radiation of the laser beam reflected in the long mirror is carried out from the interferometer unit 81.

[0033] In this way, after outgoing radiation of the interference light with the laser beam

which went back and forth between the laser beams and the long mirrors 75 which went back and forth between the criteria mirrors 96 two times two times is carried out from the interferometer unit 81 and it is reflected with the reflecting mirror 91 on the Y carriage 72, incidence is carried out to the interferometer receiver 78, and it is detected. The distance between a polarization beam splitter 95 and the criteria mirror 96 is eternal. On the other hand, the distance between a polarization beam splitter 95 and the long mirror 75 changes with movements of the substrate stage PST, the interference state of the interference light which carries out outgoing radiation becomes a thing reflecting the distance of the interferometer unit 81 and the long mirror 75 from the interferometer unit 81, and the interferometer receiver 78 measures the distance of the interferometer unit 81 and the long mirror 75 from change of an interference fringe. In the example of illustration, the direction coordinate of X of the substrate stage PST is searched for by taking the average of the distance measurement value by the interferometer unit 81, and the distance measurement value by the interferometer unit 82, the division of the difference of the distance measurement value by the interferometer unit 81 and the interferometer unit 82 is carried out in the direction distance of Y of both the interferometers units 81 and 82, and the angle of rotation of the substrate stage PST is measured. Moreover, the direction coordinate of Y of the substrate stage PST is calculated from the distance measurement value using the interferometer unit 83.

[0034] The mask stage RST which returns to drawing 1 and by which surfacing support of the mask-stage equipment 13 was carried out by non-contact above the aforementioned base 23 and the base 23 (stage main part), While driving a mask stage RST by predetermined stroke to Y shaft orientations which are scanning directions (the relative-displacement direction) X shaft orientations which intersect perpendicularly with Y shaft orientations are equipped with the mask drive system 24 which carries out a minute drive, and the frames 25 and 26 for reaction force interception (supporter) which receive the reaction force produced with the drive of the mask stage RST by this mask drive system. It is being fixed to the **** surface plate 21 shown in drawing 1, the base 19, and the base plate BP by the floor line FD through opening formed, respectively, and the end face of the frames 25 and 26 for reaction force interception misses to the floor the reaction force generated by movement of a mask stage RST. The above-mentioned reaction force is not transmitted to a projection optical system PL by these frames 25 and 26 for reaction force interception. For this reason, high exposure of precision is realizable.

[0035] The drive system of mask-stage equipment 13 has the same structure as the drive system of the substrate stage PST, and has the composition as the coordinate position detection equipment of the substrate stage PST also with the same coordinate position detection equipment of a mask stage RST using the laser interferometer. In addition, although considered as the composition which presents the shape of a KO character in which a stator carries out opening towards a stage with the form of the above-mentioned operation, as shown, for example in drawing 5, you may be the composition in which Stators 59A and 59B carry out opening towards + Z direction. In this case, what is necessary is just to make a needle into the configuration which hangs to - Z direction [into a stator]. Moreover, the Y linear motor 64 and the X linear motors 65A and 65B which are the above-mentioned linear motors can apply both of the moving-coil-type and MUBINGU magnet type form.

[0036] Moreover, this invention is applicable also to the stage equipment driven with driving gears other than a linear motor. Drawing 6 is the outline perspective diagram showing the example which applied this invention to the substrate stage equipment driven with a ball screw, and drawing 7 is the outline plan.

[0037] This substrate stage equipment is equipped with the mechanism for driving the

substrate stage PST and the substrate stage PST in which it is located above the base 19 and the base 19. A drive is equipped with the X motor 113 which carries out the rotation drive of the ball screw 114 and it, and the Y motor 103 which carries out the rotation drive of the ball screw 104 and it. Glass-substrate P is held by vacuum adsorption etc. through a non-illustrated substrate electrode holder on the upper surface of the substrate stage PST. The Y motor 103 drives the Y carriage 102 along with the Y guide 101. The X guide 111 is being fixed to -X side edge section of the Y carriage 102. It moves in the direction of Y with the Y carriage 102 by driving the Y motor 103 on the substrate stage PST, and moves in the direction of X along with the X guide 111 from driving the X motor 113.

[0038] Coordinate position measurement of X of the substrate stage PST and the direction of Y is performed using a laser interferometer like said stage equipment. For coordinate position measurement of the direction of X of the substrate stage PST, the long boundary 75 for laser interferometers is fixed through the supporter material 74 on the base 19, and the interferometer unit 121,122 which made the cube corner reflector and the plane mirror the pair on the substrate stage PST is arranged. Moreover, the long boundary 77 for laser interferometers is fixed through the supporter material 76 on the base 19 for coordinate position measurement of the direction of Y of the substrate stage PST, and the interferometer 123 which made the cube corner reflector and the plane mirror the pair on the substrate stage PST is arranged. Moreover, the reflecting mirror 131,132,133 for optical-path bending which constitutes an interferometer path is installed on the Y carriage 102.

[0039] The optical path of the laser beam which goes back and forth between the interferometer unit 122 and the long mirrors 75 is set up on the position 114 where the driving force by the X motor 113 acts on the substrate stage PST, i.e., a ball screw. In this way, the interferometer unit 122 measures the distance between the substrate stage PST and the long mirror 75 in the position where the driving force of the X motor 113 acts. By the distance measurement value by the interferometer unit 122, the direction coordinate of X of the substrate stage PST is searched for, the division of the difference of the distance measurement value by the interferometer unit 121 and the interferometer unit 122 is carried out in the direction distance of Y of both the interferometers unit 121,122, and the angle of rotation of the substrate stage PST is measured. Moreover, the direction coordinate of Y of the substrate stage PST is calculated from the distance measurement value using the interferometer unit 123.

[0040] Since the relative position of the actuator for a drive and the laser interferometer which measures a moving-part position does not change according to this invention, even if stage moving part is in which position of X and a Y coordinate system, the frequency response of a control system does not change. Therefore, it becomes filterable by the control controller and still higher controllability ability is obtained.

[0041] Moreover, in order to require flatness high to the field of a member in which a long mirror is attached in order to maintain the precision of a long mirror plane until now and to maintain it, rigidity could not but be needed, and it surely could not but become thick heavy parts. However, it can constitute from this invention, without taking into consideration to the weight of not only the weight of the main part of a long mirror but the member to support, since it is possible to have a long mirror in a fixed side. Therefore, the long mirror could be incorporated, without completely spoiling flatness.

[0042] We are anxious about the interferometer composition by this invention producing an Abbe error. Since the laser beam side which performs position measurement will move when based on the projection optical system PL which does not move during exposure especially, the error proportional to the interval (Δx or Δy) of a laser beam and a projection optical system PL will arise. However, even if it is that case, an Abbe error can

be made to cancel by applying amendment, using the error of the direction of Y as $\Delta x - \Delta \theta$ using the error of the direction of X as $\Delta y - \Delta \theta$, since it is acting as the monitor of all the variation rates of the direction of X of moving part (the substrate stage PST, mask stage RST), the direction of Y, and the direction of θ .

[0043] Although considered as the composition which applies the stage equipment of this invention to an aligner 11 with the form of the above-mentioned implementation, it is not limited to this and can apply also to precise measurement devices, such as drawing equipment of an imprint mask, and a position-coordinate measuring device of a mask pattern, besides aligner 11. As a substrate, the original edition (synthetic quartz, silicon wafer) of not only glass-substrate [for liquid crystal display devices] P but the semiconductor wafer for semiconductor devices, the ceramic wafer for the thin film magnetic heads, the mask used by the aligner, or a mask etc. is applied.

[0044] The pattern of Mask R can be exposed in the state where Mask R and glass-substrate P other than the scanned type aligner (scanning stepper; U.S. Pat. No. 5,473,410) of step - which carries out the synchronized drive of RETEKURU R and the glass-substrate P, and carries out scanning exposure of the pattern of Mask R as an aligner 11, and - scanning method were stood still, and it can apply also to the projection aligner (stepper) of a step-and-repeat method which carries out step movement of the glass-substrate P one by one. As a kind of aligner 11, it is not restricted to the aligner for liquid crystal display device manufacture, but can apply to the aligner for manufacturing an aligner, the thin film magnetic head, an image pick-up element (CCD) or a mask for the semiconductor-device manufacture which exposes a semiconductor-device pattern to a wafer, etc. widely.

[0045] Moreover, charged-particle lines, such as the bright line (g line (436nm), h line (404.7nm), i line (365nm)) and the KrF excimer laser (248nm) which are generated from an extra-high pressure mercury lamp, an ArF excimer laser (193nm), and not only F2 laser (157nm) but an X-ray, and an electron ray, can be used as the light source of the lighting light for exposure. For example, when using an electron ray, a thermocouple-emission type lanthanum HEKISABO light (LaB6) and a tantalum (Ta) can be used as an electron gun. Furthermore, when using an electron ray, it is good also as composition which uses Mask R, and is good also as composition which forms a pattern on a direct wafer, without using Mask R. Moreover, you may use higher harmonics, such as a YAG laser and semiconductor laser, etc.

[0046] Any of not only unit systems but a reduction system and an expansion system are sufficient as the scale factor of a projection optical system PL. Moreover, what is necessary is just to use the electron optics system which consists of an electron lens and deflecting system as optical system, in making it the optical system of a reflective refraction system or a refraction system using the material which penetrates far ultraviolet rays, such as a quartz and fluorite, as ** material as a projection optical system PL when using far ultraviolet rays, such as an excimer laser, when using F2 laser and an X-ray (Mask R uses a reflected type thing), and using an electron ray. In addition, the optical path which an electron ray passes cannot be overemphasized by making it a vacuum. Moreover, it can apply also to the BUROKISHIMI tee aligner which Mask R and Wafer W are made close and exposes the pattern of Mask R, without using a projection optical system PL.

[0047] You may use the flat-surface motor which the magnet unit (permanent magnet) which has arranged the magnet to two dimensions, and the armature unit which has arranged the coil to two dimensions are made to counter as a drive of each stages RST and PST, and drives each stages RST and PST with electromagnetic force. In this case, what is necessary is to connect either of a magnet unit and an armature unit to Stages RST and PST, and just to establish another side of a magnet unit and an armature unit in the move

both sides (base) of Stages RST and PST.
DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] The schematic diagram showing an example of the aligner by this invention.

[Drawing 2] The appearance perspective diagram of substrate stage equipment.

[Drawing 3] The outline plan for explaining the composition of the laser interferometer by this invention.

[Drawing 4] The schematic diagram explaining the structure of an interferometer unit.

[Drawing 5] The schematic diagram showing other examples of the substrate stage equipment by this invention.

[Drawing 6] The schematic diagram showing other examples of the substrate stage equipment by this invention.

[Drawing 7] The outline plan of the substrate stage equipment shown in drawing 7.

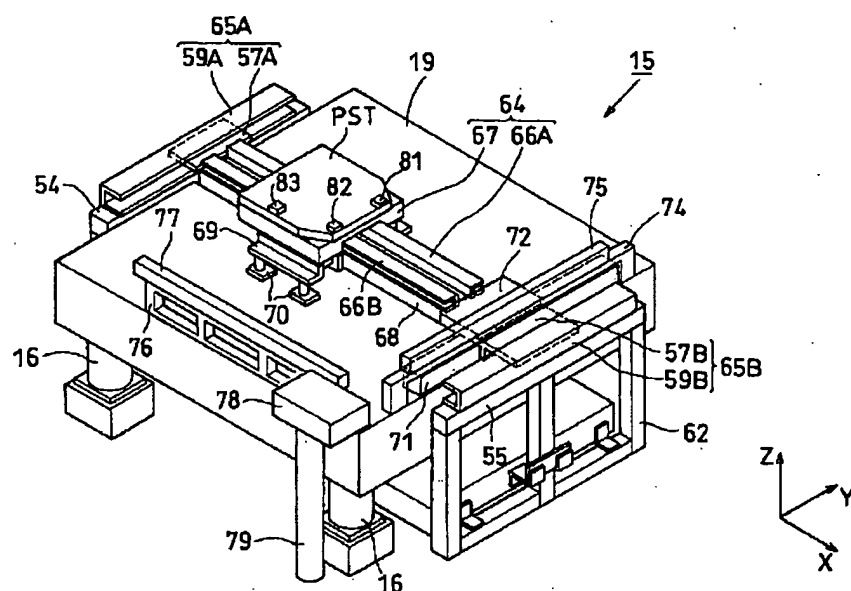
[Drawing 8] Conventional step - and the schematic diagram of the scanned type aligner of - scanning method.

[Drawing 9] The perspective diagram showing the outline composition of the conventional substrate stage.

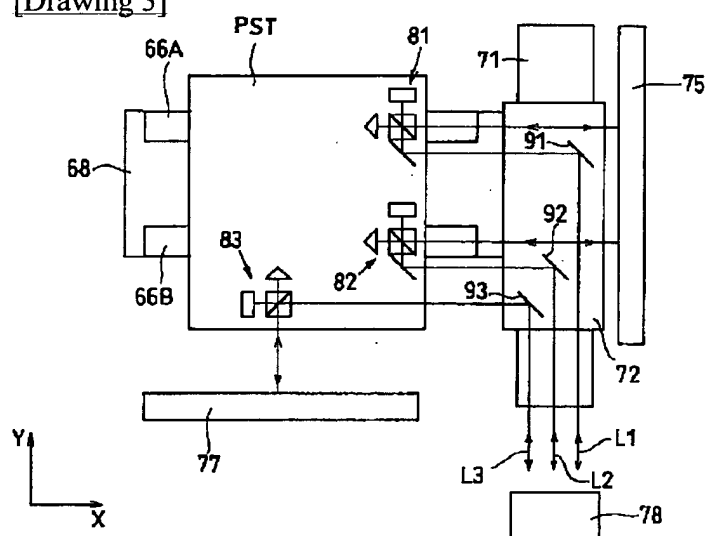
[Description of Notations]

11 [-- Mask-stage equipment, 14 / -- Main part column,] -- An aligner, 12 -- Lighting optical system, 13 15 [-- The base, 20 / -- Leg,] -- Substrate stage equipment, 16 -- A vibrationproofing base, 19 21 [-- The base, 24 / -- Mask drive system,] -- A **** surface plate, 22 -- The leg, 23 25 26 -- 54 The frame for reaction force interception, 55 -- The frame for reaction force interception, 57A, 57B [-- Supporter material,] -- A needle, 59A, 59B -- A stator, 62 64 -- X linear motor, 65A, 65 B--Y linear motor, 66A, 66B -- Stator, 67 [-- An air pad, 71 / -- Y guide,] -- X carriage, 68 -- X guide, 70 72 [-- A long boundary, 76 / -- Supporter material,] -- Y carriage, 74 -- Supporter material, 75 77 [-- Supporter material, 81 82, 83 / -- Interferometer unit,] -- A long boundary, 78 -- An interferometer receiver, 79 91, 92, 93 [-- Criteria mirror,] -- A reflecting mirror, 95 -- A polarization beam splitter, 96 97 [-- Y guide,] -- 98 A cube corner reflector, 99 -- A quadrant wavelength plate, 101 102 [-- A ball screw, 111 / -- X guide,] -- Y carriage, 103 -- Y motor, 104 113 [-- Interferometer unit,] -- X motor, 114 -- A ball screw, 121,122,123 131,132,133 [-- Light source system,] -- A reflecting mirror, 200 -- An X-Y stage, 201 207 [-- A projection optical system, 212 / -- Surface plate,] -- A mask, 210 -- A main-control system, 211 214 [-- Y guide conveyance object,] -- X guide, 216 -- The 1st mobile, 218,220 219 [-- Drive system,] -- A reticle-stage drive system, 222 -- Y guide, 223 224,226 [-- Y linear motor,] -- X linear motor, 228 -- A connection member, 232,234 236 [-- Laser interferometer,] -- A **** stage (the 2nd mobile), 242 -- Y directional-axis acceptor, 246 250 [-- A base plate, FD / -- An installation floor, IL / -- Lighting light, L1, L2, L3 / -- The laser beam for measurement, P / -- A glass substrate, PL / -- A projection optical system, PST / -- A substrate stage, R / -- A mask, RST / -- Mask stage] -- Y move mirror, 252 -- A sensitization substrate, BP

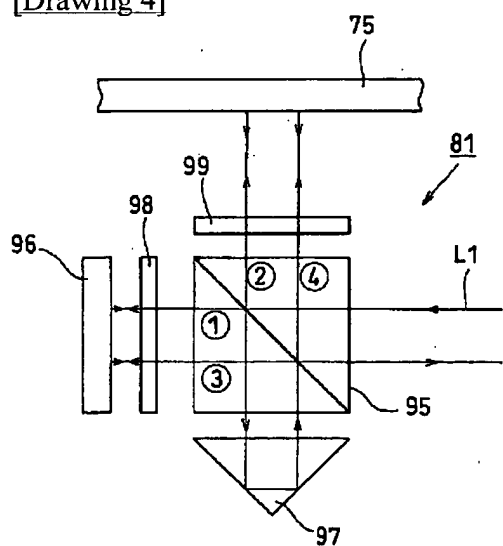
DRAWINGS



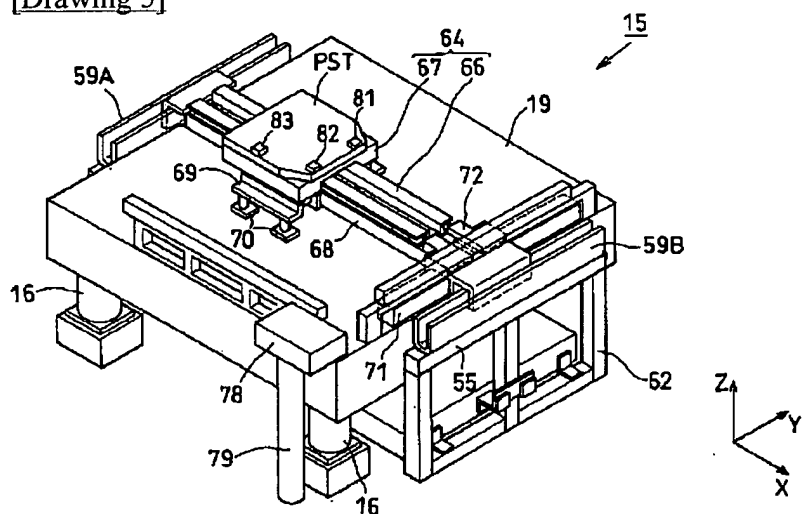
[Drawing 3]



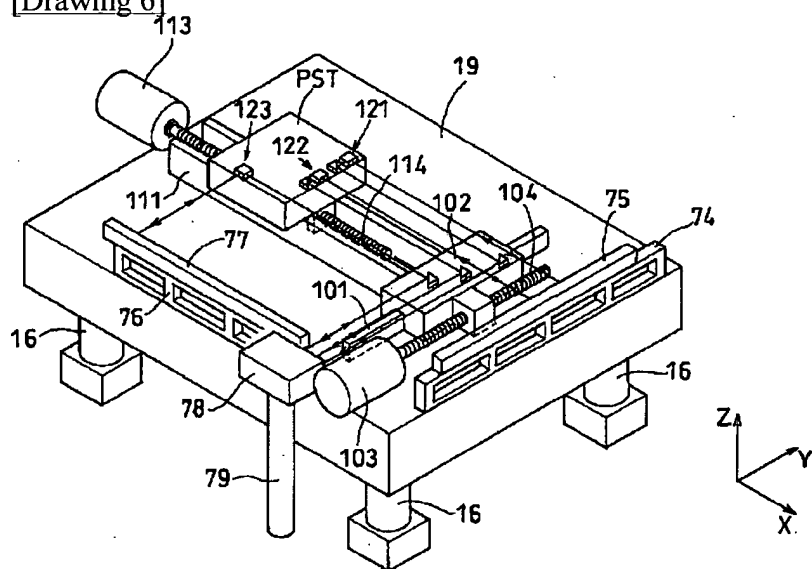
[Drawing 4]



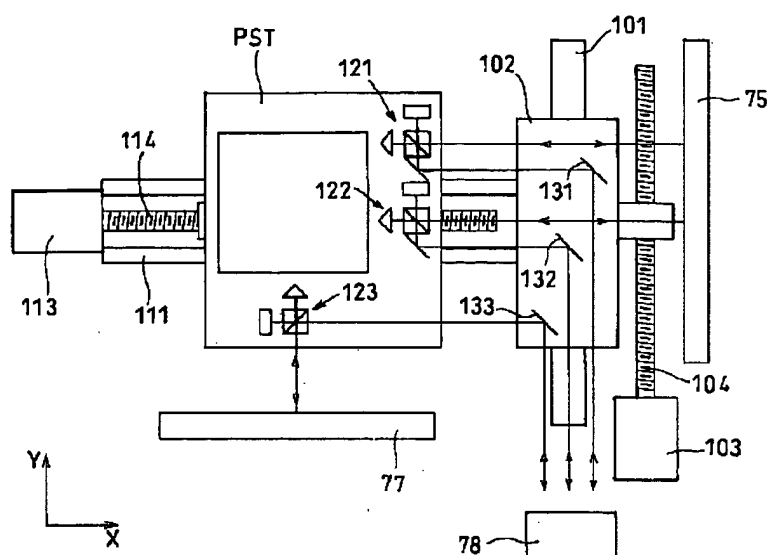
[Drawing 5]



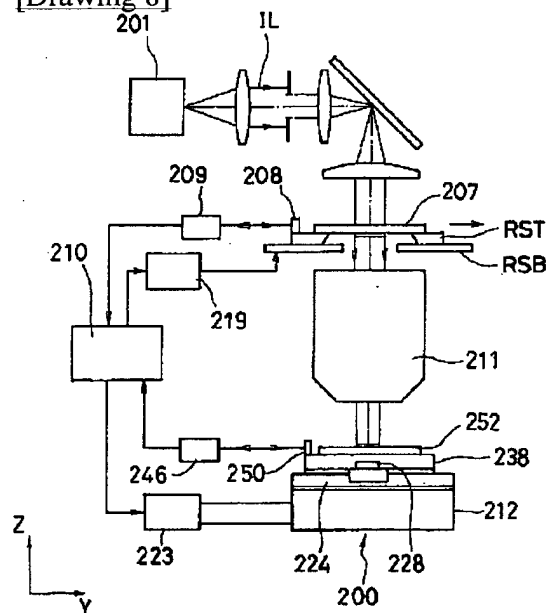
[Drawing 6]



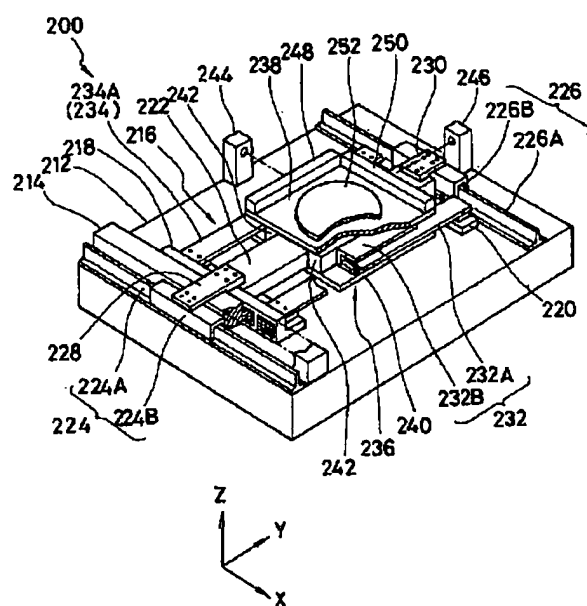
[Drawing 7]



[Drawing 8]



[Drawing 9]



[Translation done.]